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Hydrology and Hydraulics Basis of Design

Sol Orchard - Valley Center

RBF CONSULTING

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Section 1. Project Description

Section 1.1. Project Location

The 46.1-acre project site is part of a 54.6-acre property located just east of the community of Valley Center, California, within north-central San Diego County. The project site is bordered by Vesper Road to the north and Valley Center Road (County Highway S6) to the south, and is generally located between Almona Way to the west and Mac Tan Road to the east. The affected County Assessor Parcel Number (APN) is 188-290-20. Primary access to the site would occur from the north via Vesper Road. A vicinity map is included on the following page as Figure 1.

Figure 2 shows an aerial photograph of the project area. The 54.6-acre property is currently used for farming (field crops and orchards) and contains a residential structure that will remain; however, is not part of the project or MUP area. The 46.1-acre project site is currently orchards and field crops.

The primary point of concentration for project site runoff (Node 200) is located at the southwest corner of the site (adjacent to Valley Center Road). Approximately 0.92 square-miles (590 acres) drain to the concentration point.

An additional 0.7 square-miles (500 acres) drain to a culvert beneath Valley Center Road approximately 1,800-feet east of the project site (Node 300). This 4' x 12' culvert conveys a portion of the 100-year flow at Node 300 prior to a split flow condition, whereby runoff begins to drain towards the project site as well as through the culvert. A split flow analysis is included in Attachment E of this report.

Photographs of the project site are provided in Attachment B of this report.

Section 1.2. Project Purpose

The Project is intended to allow for the installation and operation of a photovoltaic electrical generation facility and represents an opportunity to provide the residents of north-central San Diego County and the greater surrounding area with clean source of electrical power from renewable sources that would supplement energy currently supplied by the existing power grid, thereby reducing the potential for power shortages to occur and decreasing demands on the capabilities of the existing distribution system.

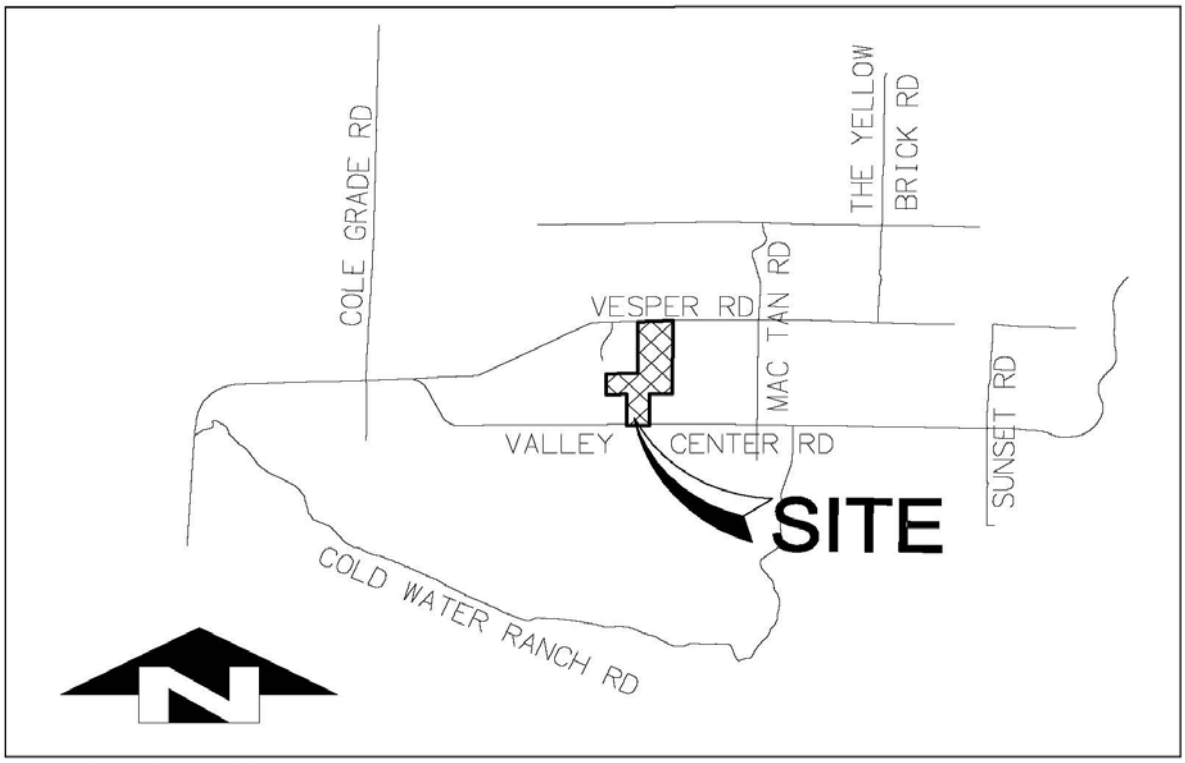
The proposed project includes two (2) alternatives for solar panel support. The preferred alternative (ALT 1) uses driven H-Pile posts for solar panel support. These posts result in a minimal increase in impervious area. Combined with the seven (7) proposed inverter pads (2,772 square feet total), alternative one increases project site impervious area by 0.10 acres.

The second alternative (ALT 2) includes a ballasted foundation system for solar panel support for a maximum of 10% of the total solar panel supports, with the remaining 90-percent of the site using driven H-pile posts for solar panel support. This alternative is considered only in the event that geotechnical limitations, such as bed rock, prevent the use of driven H-piles. Combined with the seven (7) proposed inverter pads (2,772 square feet total), alternative two increases project site impervious area by approximately 0.23 acres.

The project's structural engineer, based on existing field and soils conditions, may recommend the use of ballasted footings in lieu of the typical driven H-pile footings. Use of the ballasted footings is limited to 10% (405) of the total number of footings (i.e. solar panel supports).

Individual or series of ballasted footings may be interspersed within rows of typical driven H-pile footings. Spacing of the ballasted footings will match intervals as shown for the typical H-pile footings.

Figure 1 - Vicinity Map

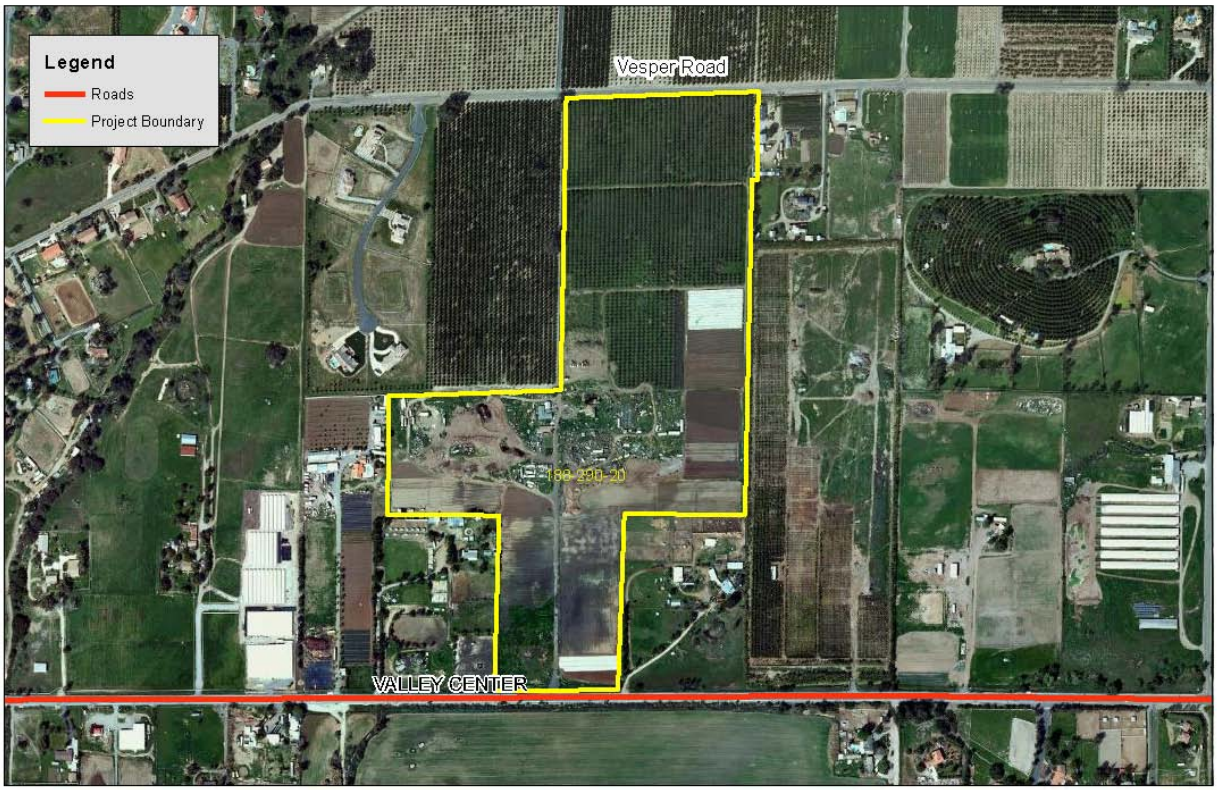


T.B. PG. 1090

VICINITY MAP

NOT TO SCALE

Figure 2 - Aerial Photograph



RBF CONSULTING GIS

Scale 1:6,000
Image: ESRI

Sol Orchard - Valley Center

AERIAL MAP

Section 2. Project Design Criteria

The calculation procedures, standards for stormwater design, and standard drawings used for this project are based upon standard County of San Diego reference manuals, including:

- San Diego County Hydrology Manual (SDCHM), June 2003
- San Diego County Drainage Design Manual (DDM), July 2005

Section 3. Scope of Report

- Identify project site run-on from upstream tributary areas for the 100-year storm event using the NRCS method (Nodes 100, 200 and 300),

- Identify the existing condition project site runoff for the 100-year storm event using the Rational Method (Node 200),

- Identify the limits of inundation across the project site for the 100-year storm event,

- Identify potential erosive conditions due project site run-on and/or runoff,

- Show that the proposed project does not create a calculable impact on the hydrologic and hydraulic properties of the site, as compared to existing conditions.

Section 4. Methodology

Section 4.1. Hydrology

Section 4.1.1. Rational Method

Design peak flow rates for the project site were developed based upon the Rational Method methodologies described in the County of San Diego Hydrology Manual. The Rational Method is a physically-based model that calculates peak flow rates (Q) as a function of drainage area (A), rainfall intensity (i), and a runoff coefficient (c):

$$Q = c * i * A$$

Section 4.1.1.1. Drainage Area (A)

Project site drainage areas were delineated based upon five-foot contour interval aerial topography obtained from Intermap. All topography and drainage areas were reviewed for consistency with the appropriate USGS Quadrangle Sheet.

Approximately 38 acres drain southerly towards the project site. Runoff from this area crosses over Vesper Road and drains through the site as sheet flow. There is no curb and gutter along Vesper Road. Photographs are presented in Attachment B.

Proposed improvements associated with the project will not require grading. Clearing and grubbing (removal of existing orchards) will be required to install the proposed solar panels. No export or import of soil is proposed; therefore, the project site drainage areas will not be significantly changed, as compared to existing conditions. A copy of the site plan is presented in Attachment B.

Section 4.1.1.2. Runoff Coefficient (c)

The pre-development runoff coefficient value was developed based upon Table 3-1 (SDCHM), which presents runoff coefficients based upon the hydrologic soil type, and the assumption of "Undisturbed Natural Terrain." This initial assumption of undisturbed terrain, despite current farming, is conservative.

The post-development runoff coefficient was developed using an area-weighted composite runoff coefficient for the project site drainage basin, based on proposed impervious area (c=0.9) and hydrologic soil types B and D.

The hydrologic soil type classifications were delineated using geographic information system (GIS) geology data available from SanGIS. The hydrologic soil type delineation was then cross-checked against Appendix A of the SDCHM to determine the hydrologic soil types associated with each delineated soil type. A project site soils map is provided in Attachment A.

Land use was established based upon current aerial photographs of the site, as well as GIS land use data published by the San Diego Association of Governments (SANDAG). The SANDAG data indicated that the project site is comprised of "Field Crops" and "Orchards." An aerial photograph of the site is provided in Figure 2.

To account for variations in land use across the site, the land use in the drainage basin was broken into Undisturbed and Impervious. Runoff coefficients for each of the two categories were assigned as follows:

- Undisturbed – Assigned by hydrologic soil type and the "Undisturbed Natural Terrain" element in Table 3-1 of the SDCHM.

- Impervious – Assigned a runoff coefficient of 0.9.

The 47.5-acre project site contains temporary existing impervious area in the form of trailers, scattered scrap metal, and other debris. These project site existing impervious areas will be removed prior to solar panel installation. In order to simplify the increase in impervious area, the site is assumed completely pervious in the existing condition. All proposed imperviousness (support posts and/or ballasted foundations, inverter pads, etc) are accounted for. The existing house is located within the 54-acre property boundary and will remain, but it is not part of the 47.5 acre MUP/project site area and thus not accounted for in the existing impervious analysis.

Section 4.1.1.3. Rainfall Intensity (i)

Rainfall intensity was developed based upon the following equation from the San Diego County Hydrology Manual (page 3-7):

$$i = 7.44 P_6 D^{-0.645}$$

The 6-hour precipitation depths (P_6) are taken from Appendix B of the SDCHM, and are presented in Attachment A.

The duration (D) used to calculate rainfall intensity is the time of concentration. The time of concentration (Tc) for each drainage basin was calculated as the summation of the initial time of concentration and the total travel time through the drainage basin.

$$Tc = Ti + Tt$$

The initial time of concentration (T_i) was taken from Table 3-2 of the SDCHM based upon the slope and the assumption of "Natural" conditions along the project site topographic high point. The travel time (T_t) through the drainage basin was developed using the Kirpich formula presented on Figure 3-4 of the SDCHM, which is valid for overland travel time through natural watersheds.

$$Tc = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

Only minimal grading is proposed (no soil export or import) and there are no storm drain improvements proposed with this project; therefore, the post-development time of concentration will remain substantially unchanged from the pre-development condition.

Section 4.1.1.4. Drainage Nodes

The following discussion pertains to the study nodes shown on the hydrologic work maps. Please refer to the hydrologic work maps found in Attachment C of this study.

Node 100: Located along the easterly project boundary, represents project site run-on (shallow concentrated flow) from a 0.71 square mile tributary area.

Node 110: Located along the northerly project boundary, represents project site run-on (sheet flow) from a 38-acre tributary area. This Node is included to determine the quantity and nature of run-on from the north. Given the flatness of the topography and the lack of curb and gutter along Vesper Road, runoff is not concentrated at Node 110, rather sheet flow. The flow path to Node 110 is intentionally disconnected from the flow path to Node 200 (Project Site). See discussion below for Node 200 (Project Site).

Node 200: Located along the southwesterly project boundary, represents the discharge point for the entire project site tributary area (0.92 square miles). The analysis at Node 200 includes the area to Nodes 100 and 110, along with the project site. As such, continuing the flow path from Node 110 to Node 200 is not necessary, as Node 200 includes the entire project site tributary area (see below: Node 200 Project Site).

Node 200 (Project Site): Located along the southwesterly project boundary, represents the project site only (46.1 acres). Analysis at Node 200 (Project Site) is intentionally disconnected from the analysis at Node 110. As a conservative measure, the project site was analyzed by itself to compare the weighted runoff coefficient between existing and proposed conditions. By doing so, the increase in project site impervious area is not diluted by including additional off-site area from the north (Node 110).

Node 300: Located east of the project site, represents runoff to an existing culvert beneath Valley Center Road (0.78 square mile tributary area). Due to the flat nature of the surrounding project site area, a split flow condition is anticipated at Node 300. Attachment D includes a split flow analysis which ultimately increases the anticipated Q-100 at Node 200. As shown in Table 4 of this study, the split flow condition at Node 300 is combined with Q-100 at Node 200 to map the project site limits of inundation.

Section 4.1.2. NRCS Method

The project site tributary watershed is approximately one square mile (mi^2), therefore, overall design peak flows were developed using the Natural Resources Conservation Service (NRCS) – formerly the Soil Conservation Service (SCS)– unit hydrograph method, and the San Diego Unit Hydrograph (SDUH) software. The SDUH program uses the following information to develop peak runoff flow rates:

- Drainage area (mi^2),
- 6-hour and 24-hour rainfall depths (in),
- Adjusted runoff curve number, and
- Watershed lag time (hr).

The project site watershed is approximately 0.9-square miles (mi^2). Per the San Diego County Hydrology Manual (June 2003), "The NRCS hydrologic method should be used for study areas approximately 1 square mile and greater in size." The watershed was delineated using United States Geologic Survey (USGS) topographic maps.

An adjusted runoff curve number (CN) was determined by assessing watershed land use, watershed soils, and precipitation zone number (PZN).

Vegetation within the project site watershed (0.9-square miles) was obtained from San Diego Geographic Information Source (SanGIS). Vegetation varies slightly throughout the tributary area; however, all vegetation is classified as one of the following five SanGIS categories:

1. Grasslands, Vernal Pools, Meadows, and Other Herb Communities (13%)
2. Non-Native Vegetation, Developed Areas, or Un-Vegetated Habitat (78%)
3. Riparian and Bottomland Habitat (2%)
4. Scrub and Chaparral (6%)
5. Woodland (1%)

Watershed land use information was also obtained from SanDAG. The watershed land use varies, but primarily consists of Spaced Rural Residential and Field Crops/Orchards. An exhibit showing the various land uses throughout the watershed is included in Attachment A.

Watershed soils information was obtained from SanGIS. Hydrologic soil type varies throughout the watershed (0.9-square miles) in the following three proportions:

1. Hydrologic Type B (71%)
2. Hydrologic Type C (23%)
3. Hydrologic Type D (6%)

The precipitation zone number (PZN) is an indicator of antecedent soil moisture condition (i.e., the saturation level of the soil from prior rainfall). The SDCHM uses PZN in two ways:

1. To adjust CN values such that they are representative of soil moisture conditions typical of different rainfall events (i.e., 5-year, 50-year, and 100-year storm events), and
2. To further adjust CN to represent orographic effects on rainfall intensity in the coastal, foothill, mountainous, and desert environments within San Diego County.

The project site watershed is located in an area of San Diego County that has a PZN of 2.5. Based upon Table 4-6 of the San Diego County Hydrology Manual, the PZN Adjustment Factor for a location with a PZN of 2.5 and a storm return period of less than 35-years is 2.25. For a storm with a return period of greater than 35 years, the PZN Adjustment Factor is 3.0. These values were obtained by using the PZN of 2.5 found from Figure C-1 of the SDCHM and linearly interpolating between the values found in Table 4-6 of the SDCHM.Using the land use and soils information for the watershed, a weighted runoff curve number equal to 71 was calculated using Table 4-2 of the San Diego County Hydrology Manual. Based on adjustment factors outlined in Chapter 4 of the SDCHM, an adjusted curve number of 86 was calculated. Calculations pertaining to the adjusted curve number can be found in Attachment C.

Watershed lag time was developed using the United States Army Corps "Corps Lag" equation. The Corps Lag equation is:

$$T_1 = 24\bar{n}\left[\frac{L \times L_c}{s^{0.5}}\right]^m \qquad \text{(SDCHM, Eq. 4-17)}$$

where:

T_1	Corps lag time (hours)
L	Length to longest watercourse (miles)
L_c	Length along the longest watercourse to a point opposite the watershed centroid (miles)
s	Overall slope of the drainage area between the headwaters and the collection point (feet/mile)
m	A constant determined by regional flood reconstitution studies (0.38 for San Diego County)
$\bar{n}$	Average of the Manning's n values for the watercourse and its tributaries

Watershed lag time was checked against the resultant flow rate, flow length, and a flow velocity calculated using Manning's Equation to confirm that the calculated time of concentration is reasonable. Table 1 presents the watershed characteristics used to calculate the watershed lag time at each study node.

Table 1 – Summary of Watershed Hydrologic Characteristics

Study Node	Total Drainage Area	Flowpath Length	Length to Centroid	High Elevation	Low Elevation	Channel Slope	Adjusted Curve Number	Corps Lag Time
	(mi^2)	(mi)	(mi)	(ft)	(ft)	(ft/mi)		(hr)
100	0.71	1.70	0.82	1720	1410	182	86	0.76
200	0.92	1.96	0.86	1720	1420	153	86	0.84
300	0.78	1.70	1.00	1700	1420	165	86	0.83
Node 100 is located along the easterly project boundary and represents watershed "Run-on" *Node 200 is located along the westerly project boundary and represents total watershed "Run-off"* *Node 300 Split flow from south-easterly watershed (0.8-square miles)*								

Section 4.2. Hydraulics

Section 4.2.1. Normal Depth Calculations

Off-site flow through the project site will concentrate in depressions, low-lying areas and shallow channels. To determine the hydraulic characteristics of project site run-on, normal depth calculations were developed. Normal depth calculations involve an iterative solution of Manning's equation in order to develop the normal depth, which is the depth of flow attained in an infinitely long channel of constant cross section and slope where uniform flow occurs.

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Normal depth computations were performed using Flowmaster software, and are based upon a given channel geometry (cross section and slope), channel roughness, and flow rate. The channel roughness was taken from Table A-5 of the San Diego County Drainage Design Manual. A representative channel cross section and slope were developed based upon the best available topographic information and field observations.

Section 4.2.2. Off Site Culvert Analysis

As mentioned in Section 1.1 of this study, an existing culvert conveys flow draining to Node 300 beneath Valley Center Road approximately 1,800 feet east of the project site (see the Watershed Hydrologic Work Map in Attachment C). Based on a site visit conducted by RBF Consulting on July 21, 2011, the spillover point, whereby runoff starts to drain to the project site in addition to beneath Valley Center road, was estimated at the soffit of the 4-foot by 12-foot culvert. Therefore, once the headwater exceeds four feet, runoff at Node 300 potentially drains to the project site. This additional flow has been added to the off-site runoff at Node 200 to analyze the anticipated depth of flow across the site during the 100-year storm event.

Section 4.2.3. Scour and Erosion

The project proposes to construct solar arrays on driven H-piles or ballasted foundation systems. In order to assess the level of erosion risk posed by concentrated flow, a simplified erosion analysis was performed. A typical rule of thumb is that erosion and associated scour are unlikely to occur for flow velocities less than or equal to 5 feet per second. The results of the 100-year normal depth calculations discussed in Section 4.2.1 were reviewed to determine if an erosive condition is likely to exist onsite.

Section 4.2.4. Flood Inundation

Inundation carries with it the risk of erosion or flood damage to proposed infrastructure. In order to assess the flooding risk on the project site, both Federal Emergency Management Agency (FEMA) and County of San Diego floodplain maps were reviewed. All information relating to existing regulatory floodplain delineations, or lack thereof, is presented in Attachment E.

In addition, the results of the 100-year storm run-on normal depth calculations discussed in Section 4.2.1 were compared to the site topography to determine an anticipated depth of flow under 100-year conditions.

Section 5. Results

Section 5.1. Hydrology

Section 5.1.1. Rational Method

The results of the 100-year Rational Method hydrologic analysis are presented in Table 2 below. Table 2 presents the drainage area, runoff coefficient, time of concentration, rainfall intensity, and peak 100-year flow rates (pre-development and post development) for the project site drainage basin. The hydrologic calculations for the 100-year storm event are presented in Attachment C.

Table 2 - Summary of 100-year Hydrology (Rational Method)

Node	Area	Runoff Coefficient	Time of Concentration	Rainfall Intensity	100-year Peak Flow Rate
	(ac)		(min)	(in/hr)	(cfs)
110	38	0.26	13.6	5.3	52.3
200 EX	46.1	0.27	21.5	3.9	48.7
200 PR: ALT 1	46.1	0.27	21.5	3.9	48.7
200 PR: ALT 2	46.1	0.27	21.5	3.9	48.7
No change to Node 110: run-on from northerly tributary area *EX = Existing Condition* *PR = Proposed Condition* *ALT 1 = Driven H-Pile Posts* *ALT 2 = 10% of Site – Ballasted Foundation; 90% of site Driven H-Pile Posts*					

Section 5.1.2. NRCS Method

The results of the 100-year NRCS Method hydrologic analysis are presented in Table 3 below. Table 3 presents the drainage area, curve number, Corps lag time, and peak 100-year flow rate for each of the studied watersheds. The hydrologic calculations for the 100-year storm event are presented in Attachment C.

Table 3 - Summary of Watershed 100-year Hydrology (NRCS Method)

Node	Area	Adjusted Curve Number (CN)	Lag Time	100-year Peak Flow Rate
	(mi^2)		(hours)	(cfs)
100	0.71	86	0.76	896
200	0.92	86	0.84	1,091
300	0.78	86	0.83	933
Note: The minimal project site increase in imperviousness does not impact watershed CN, Lag Time or 100-year peak flow rate, as compared to existing conditions.				

Section 5.2. Hydraulics

Section 5.2.1. Normal Depth

The results of the normal depth open channel calculation for the watershed peak 100-year flood flow are presented in Table 4. Table 4 presents the tributary watershed peak 100-year flow rate (Q_{100} at Node 200 plus additional runoff from the spilt flow analysis), flow depth, water surface elevation, inundation top width, and average flow velocity for each cross section analyzed. One project site representative cross section was developed from project site topography and information observed during site visits. See Attachment D for a project site inundation exhibit.

Table 4 - Summary of 100-year Hydraulics

Cross Section	100-year Peak Flow Rate	Flow Depth	Top Width	Flow Velocity
	(cfs)	(ft)	(ft)	(fps)
A	1,755	1.1	1,077	3.0
B	52.3	0.1	850	0.7
A: *Peak Flow Rate = Tributary area runoff at Node 200 plus bypass flow at Node 300 (existing culvert): = 1,091 + 664* B: C*ross section conservatively assumed as a rectangle as wide as the project site*				

Section 5.2.2. Erosion and Scour

The average flow velocity across the site is presented in Table 4. Based upon the rule of thumb that states that erosion may occur for flow velocities exceeding 5 feet per second, no erosive condition is anticipated on the project site. The results of hydraulic analysis for peak runoff generated are presented in Attachment D.

A non-toxic, biodegradable, permeable soil-binding agent or permeable rock material will be applied to all disturbed or exposed surface areas as follows: a) A permeable soil-binding agent suitable for both traffic and non-traffic areas shall be used. These agents shall be biodegradable, eco-safe, with liquid copolymers that stabilize and solidify soils or aggregates and facilitate dust suppression; or, b) Alternatively, a permeable rock material consisting of either river stone decomposed granite or gravel could be placed in a thin cover over all exposed surface area in-lieu of the binding agent referenced above. In-lieu of, or in combination with a) and b) above, the areas located between the arrays, and any non-drivable surface may be revegetated with native noninvasive plant species.

The universal soil loss equation has been used per guidelines found on page 5.7 of the San Diego County Hydrology Manual (June 2003). As described in Section 5.2.6.1 of the SDCHM, the rainfall erosion index (R) is based on the 2-year, 6-hour intensity. The soil erodibility factor (K) has been selected based on an average value obtained from using both the NRCS web-soil survey and the K-factors given in Table 5-2 of the SDCHM. The slope length and steepness factors (Ls) have been calculated using project site topography and Figure 5-5 from the SDCHM. The cropping management factor (C) has been calculated using Table 5-3 from the SDCHM. The erosion control practice factor (P) has been calculated using Table 5-6 from the SDCHM. The anticipated soils loss (As: tons, dry weight) is 0.12. Supporting calculations are found in Attachment D of this report.

Section 5.2.3. Flood Inundation

Based upon a review of floodplain mapping available from FEMA and the County of San Diego, no regulatory floodplain exists on the project site. The project site lies within un-shaded zone X, which correlates with areas outside the 500-year floodplain.

Using project site topography, field observations, and off-site hydrology, the anticipated 100-year depth of flow across the site is 1.1 feet. All proposed structures, including the solar panels at maximum tilt and the inverter pads will be raised one foot above the 100-year base flood depth of 1.1 feet. An exhibit showing the limits of inundation is included in Attachment D.

Section 6. Summary

Section 6.1. Conclusions and Recommendations

The following are conclusions and design recommendations based upon the analysis presented in this report and its Attachments:

- The NRCS method was used to calculate the 100-year peak flow rate at both the project site run-on and runoff boundaries (Node 100: 896 cfs; Node 200: 1,091 cfs). A normal depth hydraulic analysis of the project site was performed using results from the hydrologic analysis to determine an anticipated depth of inundation,

- The Rational Method was used to calculate the 100-year, existing condition, project site peak flow runoff (48.7 cfs),

- The anticipated depth of inundation is a function of the easterly run-on (Node 100), and is conservatively calculated as 1.1 feet. All solar panels (at maximum tilt) and inverter pads shall be elevated so that the lowest horizontal structural member is at least one foot above the anticipated inundation depth established within this study,

- Due to the sheet flow nature of southerly run-on, erosive velocities (greater than or equal to 5 feet per second) are not anticipated. A non-toxic, biodegradable, permeable soil-binding agent or permeable rock material shall be applied to all disturbed or exposed surface areas,

- Based on the size of the project site (46.1 acres) and the minimal amount of proposed impervious area associated the proposed project, the increase to the proposed condition composite runoff coefficient is less than 0.01 for both alternatives. Therefore, there is no anticipated increase in project site peak flow runoff, and peak flow attenuation is not necessary.

Section 6.2. CEQA Guidelines for Determining Significance

1. **Will the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?**

The project will not alter the existing drainage pattern across the site. Upon completion of the project, runoff will continue to sheet flow southwesterly towards Valley Center Road as it does in the existing condition. As runoff sheet flows off the solar panels, the permeable soil binder (mentioned above) will prevent significant erosive and allow runoff to continue in a sheet flow manner off-site. Proposed improvements will not concentrate runoff leaving the site.

2. **Will the project increase water surface elevation in a watercourse within a watershed equal to or greater than 1 square mile, by 1 foot or more in height and in the case of the San Luis Rey River, San Dieguito River, San Diego River, Sweetwater River and Otay River, 2/10 of a foot or more?**

   The project will not increase water surface elevations across the site or downstream. Proposed improvements will not alter the existing hydrologic and hydraulic properties of the site. No increase in peak flow discharge is anticipated as a result of the proposed project.

3. **Will the project result in increased velocities and peak flow rates exiting the project site that could cause flooding downstream or exceed the storm water drainage system capacity serving the site?**

   The project will not increase runoff velocities or peak flow rates leaving the site. Runoff will continue to sheet flow as it does under existing conditions. The project will not cause flooding downstream, nor will it hydraulically impact downstream storm water infrastructure.

4. **Will the project result in placing housing, habitable structures, or unanchored impediments to flow in a 100-year floodplain area or other special flood hazard area, as shown on a FIRM, a County Flood Plain Map or County Alluvial Fan Map, which would subsequently endanger health, safety and property due to flooding?**

   There are no habitable structures proposed as part of the project. All proposed solar panels and inverters will be anchored down.

5. **Will the project place structures within a 100-year flood hazard or alter the floodway in a manner that would redirect or impede flow resulting in any of the following:**

   a) **Alter the line of inundation resulting in the placement of other housing in a 100 year flood hazard**

   b) **Increase water surface elevation in a watercourse with a watershed equal to or greater than 1 square mile by 1 foot or more in height and in the case of the San Luis Rey River, San Dieguito River, San Diego River, Sweetwater River and Otay River, 2/10 of a foot or more?**

      The project will not place structures within a 100-year flood hazard or alter the floodway in a manner that will redirect of impede flow.

Section 7. References

County of San Diego. (2005). *San Diego County Drainage Design Manual.* San Diego: County of San Diego.

County of San Diego. (June 2003). *San Diego County Hydrology Manual.* San Diego: County of San Diego.

Attachment A - Watershed Information

Project Site Soils


117° 0' 22"
116° 59' 57"
33° 14' 9"
33° 13' 40"
499500
499600
499700
499800
499900
500000
3677400
3677300
3677200
3677100
3677000
3676900
3676800
3676700
3676600
Stream
Vesper Rd
Almona Way
Valley Center Rd
VaA
Co
PfC
Map Scale: 1:4,270 if printed on A size (8.5" x 11") sheet.
N
Meters
0 40 80 160 240
Feet
0 150 300 600 900

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:4,270 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 6, Dec 17, 2007

Date(s) aerial images were photographed: 6/7/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Co	Clayey alluvial land	D	8.3	14.9%
PfC	Placentia sandy loam, thick surface, 2 to 9 percent slo pes	D	1.9	3.4%
VaA	Visalia sandy loam, 0 to 2 percent slopes	B	45.7	81.7%
Totals for Area of Interest			**55.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

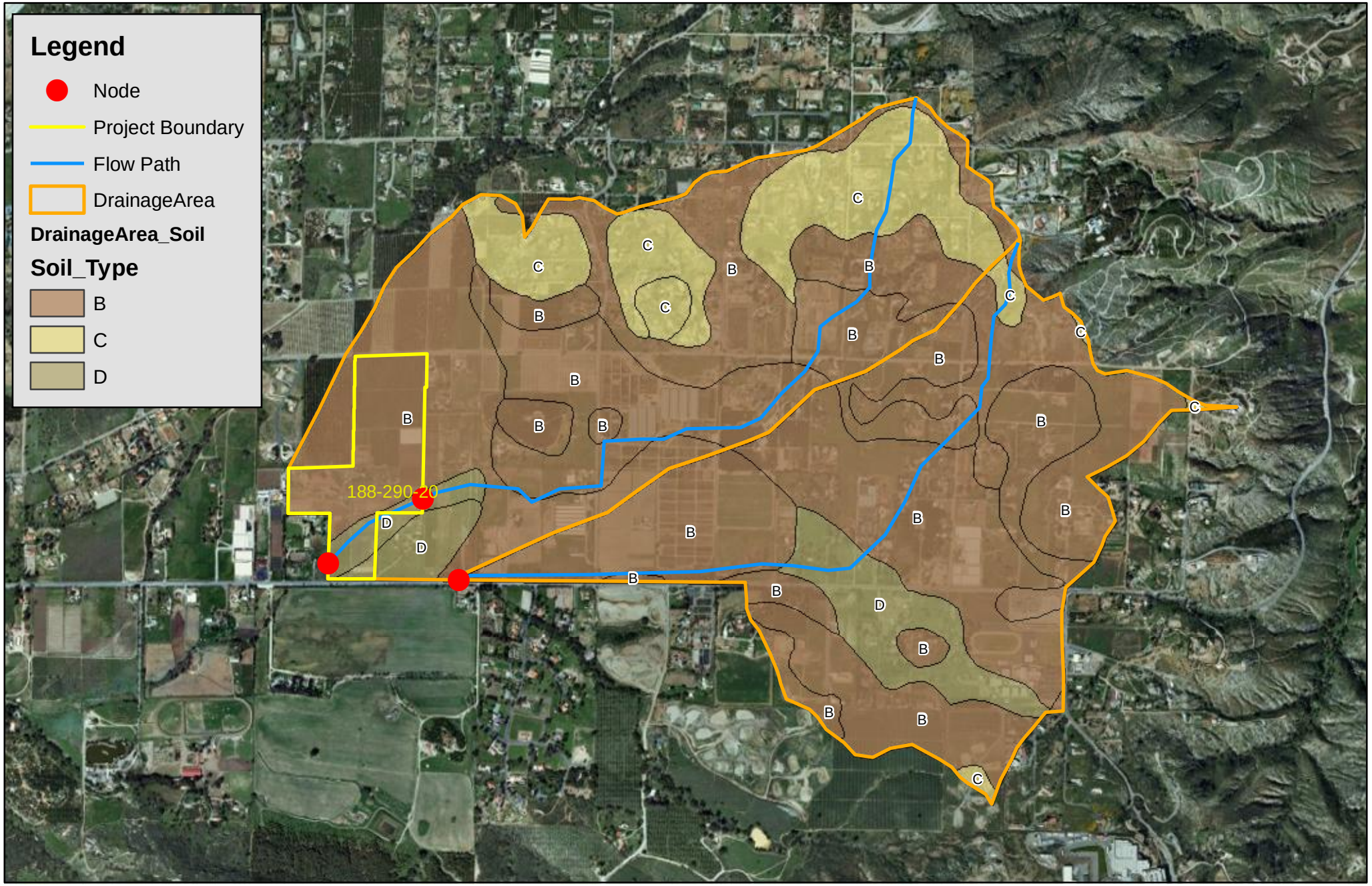
Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition



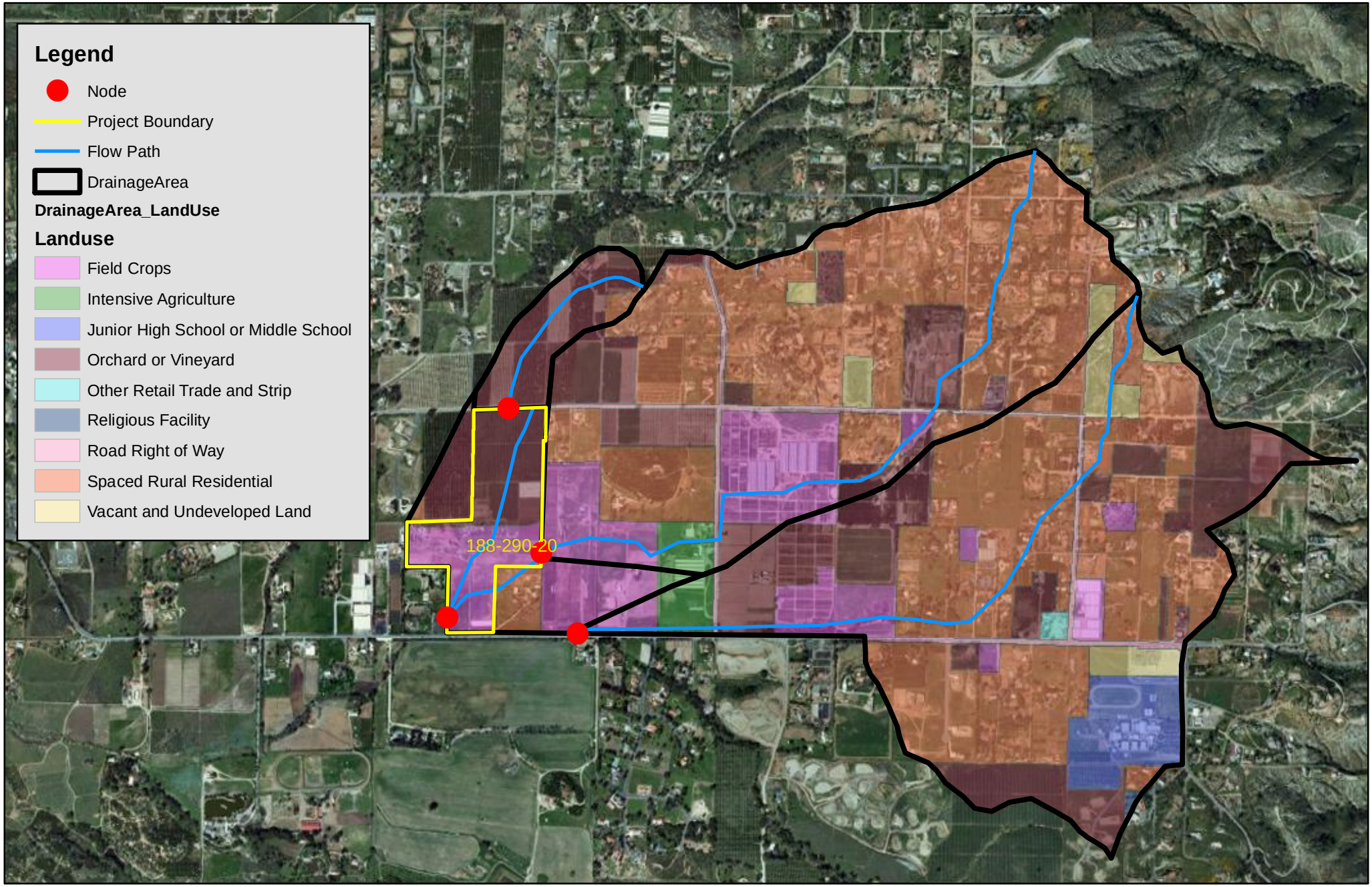
RBF CONSULTING GIS

Scale 1:18,000
Image: ESRI

Valley Center

WATERSHED SOIL MAP

Watershed Land Use



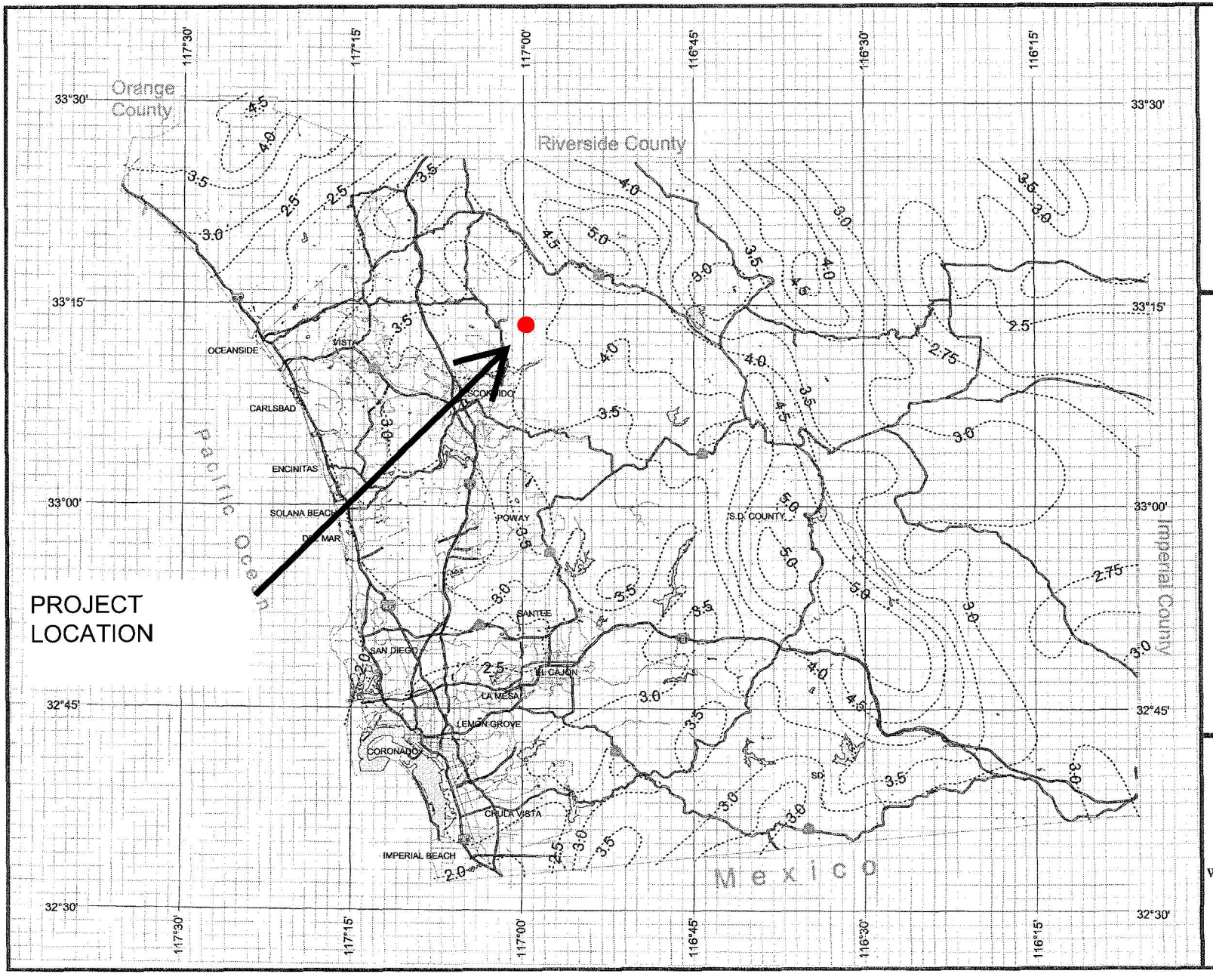
RBF CONSULTING GIS

Scale 1:18,000
Image: ESRI
Land Use Shapefile: SanDAG

Sol Orchard - Valley Center

LAND USE MAP

Watershed Isopluvials



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

P(6)100 = 3.8 IN

DPW GIS
Department of Public Works
Geographic Information Services

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N
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S

3 0 3 Miles

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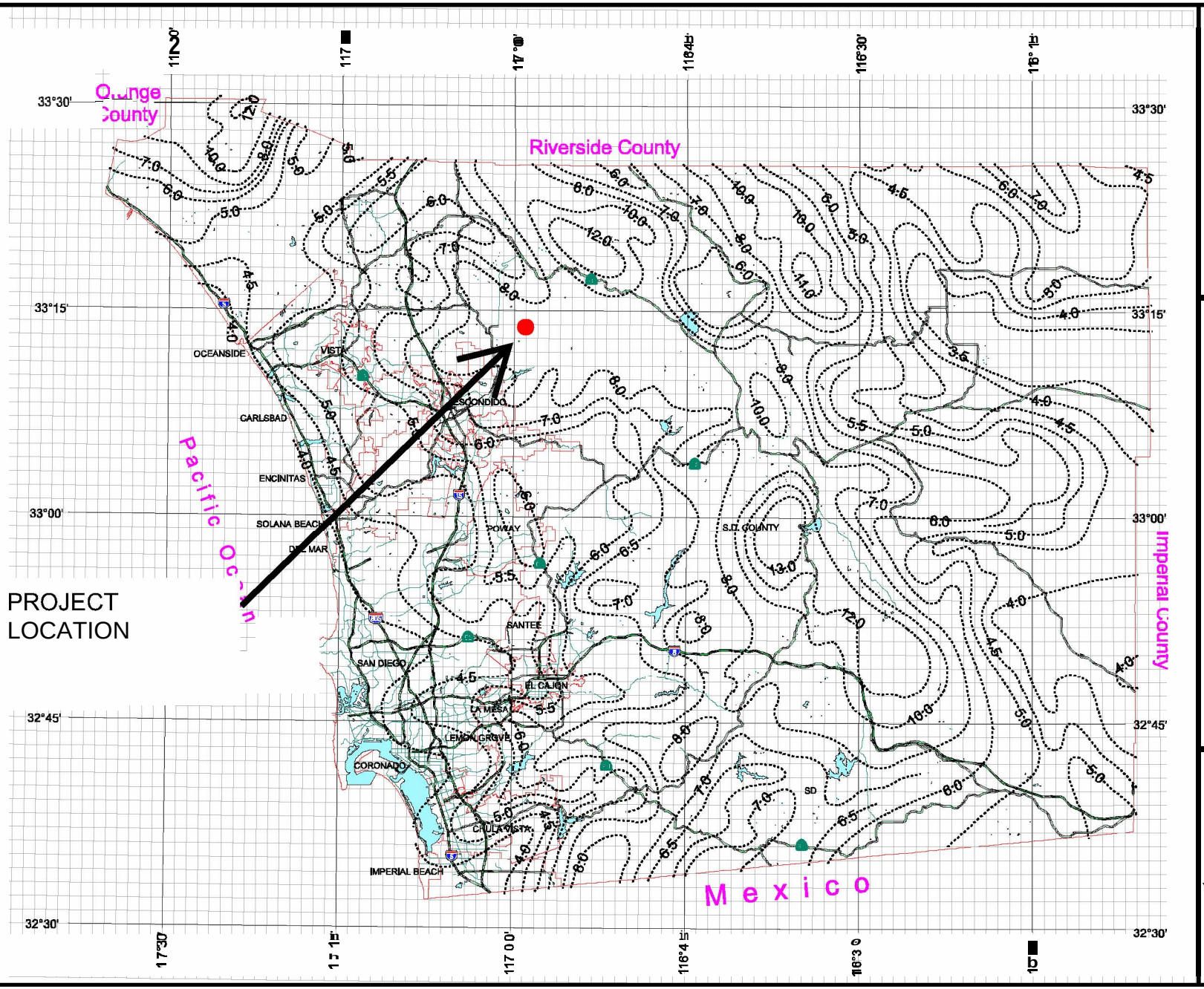
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

[redacted]

P(24)100 = 8.5 IN



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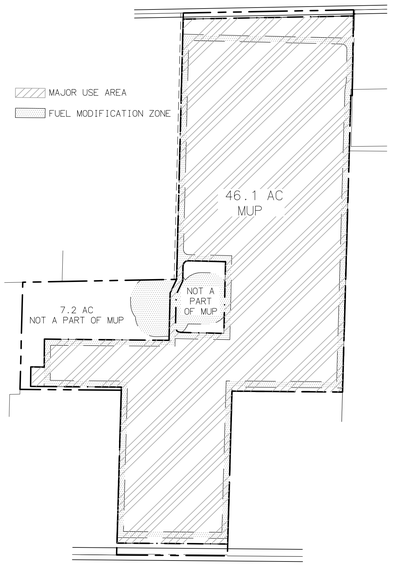
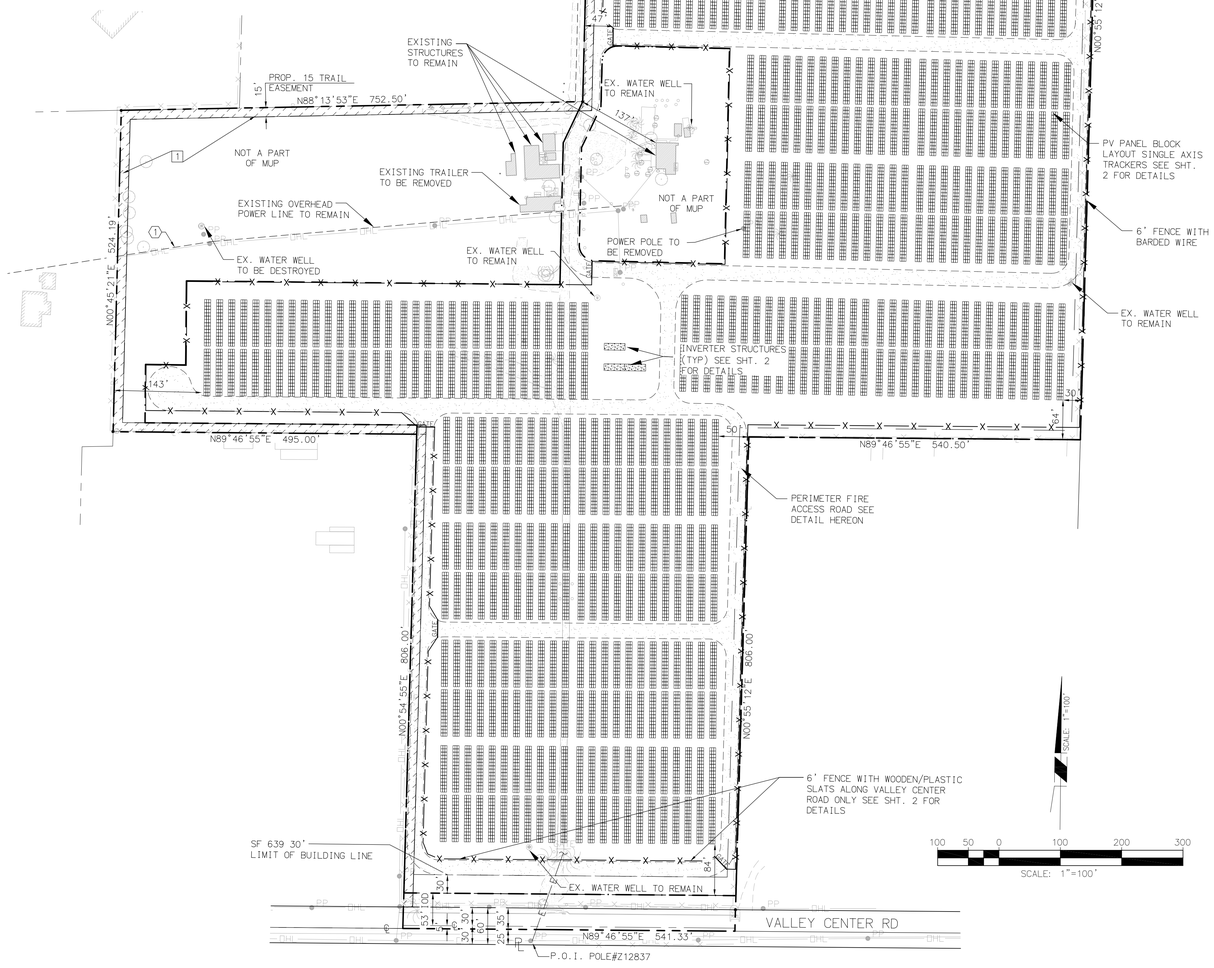
3 0 3 Miles

Attachment B - Project Site Information

Site Plan



LIMITS OF MAJOR USE AREA & FUEL MODIFICATION ZONE
SCALE: 1"=300'

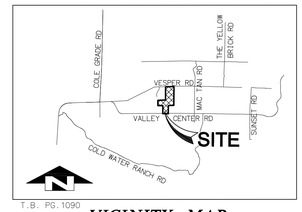


LEGEND:

- PROPERTY BOUNDARY
- MAJOR USE PERMIT BOUNDARY
- EXISTING EASEMENT
- ZONING ORD. SETBACK LINE
- EX. FENCE
- PROP. 6' CHAINLINK FENCE WITH 2 STRAND BARBED WIRE
- PROPOSED ACCESS GATE (24')(9)
- EX. DG ROAD (18'-22')
- EX. PAVEMENT
- PROP. 24' DG FIRE ACCESS ROAD-ALL WEATHER (10% MAX)
- EX.SFD/OUT BUILDINGS
- EX. OVERHEAD POWERLINE
- PROP. INTERCONNECT UNDERGROUND
- EX. POWER POLE
- EX. FIRE HYDRANT
- EX. WATER METER
- EX. WATER WELL (5)
- PROP. INVERTER/TRANSFORMER PLATFORM (7)
- PROP. PV PANEL (POLYCRYSTALLINE) BLOCK SINGLE AXIS TRACKER

ZONING

ZONE		
USE REGULATIONS		A70
NEIGHBORHOOD REGULATIONS		L
DEVELOPMENT REGULATIONS	DENSITY	0.5
	LOT SIZE	2 AC
	BUILDING TYPE	C
	MAXIMUM FLOOR AREA	--
	FLOOR AREA RATIO	--
	HEIGHT	G
	LOT COVERAGE	--
	SETBACK	C
	OPEN SPACE	--
SPECIAL AREA REGULATIONS		--



T.B. PG. 1090

VICINITY MAP
NOT TO SCALE

EXISTING EASEMENTS*

	DESCRIPTION	DISPOSITION
①	SDG&E EASEMENT	A PORTION TO REMAIN
②	PRIVATE 12' ROAD EASEMENT	TO REMAIN

* BASED ON DATA FROM PRELIMINARY TITLE REPORT BY TICOR TITLE INSURANCE COMPANY, ORDER NO. 2252620-CD, DATED JUNE 24, 2011.

PROPOSED EASEMENTS

	DESCRIPTION
1	15' TRAIL EASEMENT

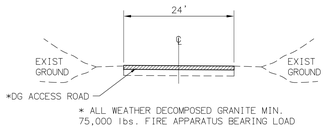
NOTES

1. GROSS AREA: 54.6 ACRES
   NET AREA: 53.3 ACRES
2. MUP AREA: 46.1 ACRES
3. TOPOGRAPHIC SOURCE: INTERMAP, FLOWN 2005
4. ASSOCIATED REQUESTS: NONE
5. THE APPROVAL OF THIS MAJOR USE PERMIT (MUP) AUTHORIZES THE FOLLOWING: CONSTRUCTION, OPERATION, AND MAINTENANCE OF AN UNMANNED PHOTOVOLTAIC SOLAR FARM PURSUANT TO SECTION 6952, OF THE SAN DIEGO COUNTY ZONING ORDINANCE.
6. THIS PLAN IS PROVIDED TO ALLOW FOR FULL AND ADEQUATE DISCRETIONARY REVIEW OF A PROPOSED DEVELOPMENT PROJECT. THE PROPERTY OWNER ACKNOWLEDGES THAT ACCEPTANCE OR APPROVAL OF THIS PLAN DOES NOT CONSTITUTE AN APPROVAL TO PERFORM ANY GRADING SHOWN HEREON, AND AGREES TO OBTAIN VALID GRADING PERMIT BEFORE COMMENCING SUCH ACTIVITY, IF REQUIRED.
7. ALL PROPOSED STRUCTURES TO BE CONSTRUCTED OF NON-COMBUSTIBLE MATERIALS (CONCRETE, BLOCK, METAL) OR SIMILAR.
8. LANDSCAPING PROPOSED SEE SHEET 3.
9. LIGHTING FOR MAINTENANCE AND SECURITY PROPOSES ONLY. SHIELDED LIGHTING LOCATED AT GATES AND SHALL CONFORM TO COUNTY OF SAN DIEGO OUTDOOR LIGHTING REQUIREMENTS. SEE DETAIL ON SHEET 2.
10. PHASING - PROJECT MAY BE IMPLEMENTED IN SEVERAL PHASES WITHOUT REGARD TO SEQUENCE.
11. ALL DISTURBED AREAS WITHIN MUP AREA WOULD BE COVERED WITH GRAVEL OR A PERMEABLE BINDING AGENT TO REDUCE DUST.
12. NO GRADING PROPOSED.
13. NO SIGNAGE PROPOSED, EXCEPT FOR DIRECTIONAL AND SAFETY SIGNAGE.
14. EXISTING SINGLE FAMILY AND 3 OUT BUILDING LOCATED OUTSIDE OF MUP AREA. PROJECT ACCESS FROM VESPER ROAD.
15. ALL SITE ACCESS GATES TO BE EQUIPPED WITH FIRE DEPARTMENT APPROVED STROBE LIGHT ACTIVATION AND KNOX KEY-OPERATED SWITCH.
16. THE SOLAR RELATED FACILITIES (PANELS, RACKING, ELECTRICAL CAONNECTIONS, INVERTER STRUCTURES, FENCING AND INTERNAL ACCESS, ETC.) SHOWN ON THIS PLOT PLAN MAY BE RELOCATED, RECONFIGURED, AND/OR RESIZED WITHIN THE SOLAR FACILITY DEVELOPMENT AREA WITH THE ADMINISTRATIVE APPROVAL OF THE DIRECTOR OF DPLU WHEN FOUND IN CONFORMANCE WITH THE INTENT AND CONDITIONS OF PERMIT'S APPROVAL.
17. WATER DISTRICT: VALLEY CENTER MUNICIPAL WATER DISTRICT.
18. FIRE DISTRICT: VALLEY CENTER FIRE PROTECTION DISTRICT.
19. GENERAL PLAN DESIGNATION: SEMI-RURAL RESIDENTIAL 4 (SR-4) .

LAND USE SUMMARY

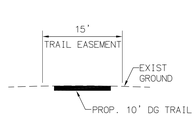
DESCRIPTION	ACREAGE	% OF SITE
BUILDING & TRANSFORMER PADS	0.06	0.11
MACHINE PIER COVERAGE	0.12	0.22
ACCESS ROADS	5.96	10.92
REMAINDER AREAS WITHIN MUP	39.92	73.13
RIGHT-OF-WAY DEDICATION/IOD	1.30	2.38
AREA OUTSIDE OF DEVELOPMENT AREA	7.23	13.24
OVERALL PROJECT SITE	54.59	100

NOTE: DENSITY CALCULATION NOT APPLICABLE UNINHABITED SITE

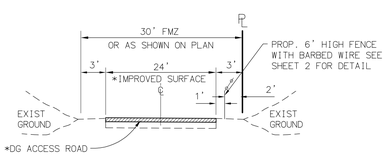


* ALL WEATHER DECOMPOSED GRANITE MIN. 75,000 lbs. FIRE APPARATUS BEARING LOAD

TYPICAL SECTION
INTERNAL FIRE ACCESS ROAD
NOT TO SCALE

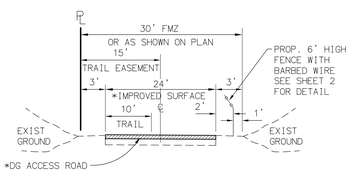


TYPICAL SECTION
TRAIL EASEMENT
NOT TO SCALE



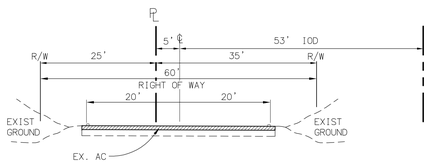
* ALL WEATHER DECOMPOSED GRANITE MIN. 75,000 lbs. FIRE APPARATUS BEARING LOAD

TYPICAL SECTION
PERIMETER FIRE ACCESS ROAD W/O TRAIL
NOT TO SCALE
*TYPICAL LOCATION UNLESS SHOWN OTHERWISE ON PLOT PLAN

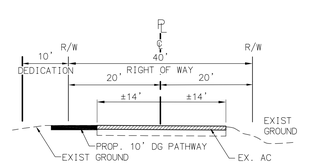


* ALL WEATHER DECOMPOSED GRANITE MIN. 75,000 lbs. FIRE APPARATUS BEARING LOAD

TYPICAL SECTION
PERIMETER FIRE ACCESS ROAD W/ TRAIL
NOT TO SCALE
*TYPICAL LOCATION UNLESS SHOWN OTHERWISE ON PLOT PLAN



TYPICAL SECTION
VALLEY CENTER ROAD
NOT TO SCALE



TYPICAL SECTION
VESPER ROAD
NOT TO SCALE

ASSESSOR PARCEL NUMBER/TAX RATE AREA

188-290-20 TRA 94075

LEGAL DESCRIPTION

THAT PORTIONS OF THE SOUTHWEST QUARTER OF SECTION 8, TOWNSHIP 11 SOUTH, RANGE 1 WEST, SAN BERNARDINO MERIDIAN, IN THE COUNTY OF SAN DIEGO, STATE OF CALIFORNIA

APPLICANT/OWNER:

SOL ORCHARD LLC
PO Box 222416,
Carmel, CA 93923,
(831) 659-8200
CONTACT: WILL PRICHARD

SHEET INDEX

SOL ORCHARD - VALLEY CENTER PHOTOVOLTAIC SOLAR FARM
COUNTY OF SAN DIEGO, CA
MAJOR USE PERMIT

TITLE SHEET / PLOT PLAN
OCT. 21, 2011
SHEET 1 OF 3

RBF CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION
9755 CLAREMONT MESA BOULEVARD, SUITE 100
SAN DIEGO, CALIFORNIA 92124-1324
858.614.5000 • FAX 858.614.5001 • www.RBF.com

H:\PDATA\25104980\003-VALLEYCENTER\CADD\PLANNING\WORK\14980-VC-MUP-01.DWG KBUTTS 10/18/2011 3:51 PM

Site Photographs

Off-site tributary area run-on location (looking easterly along easterly project boundary)

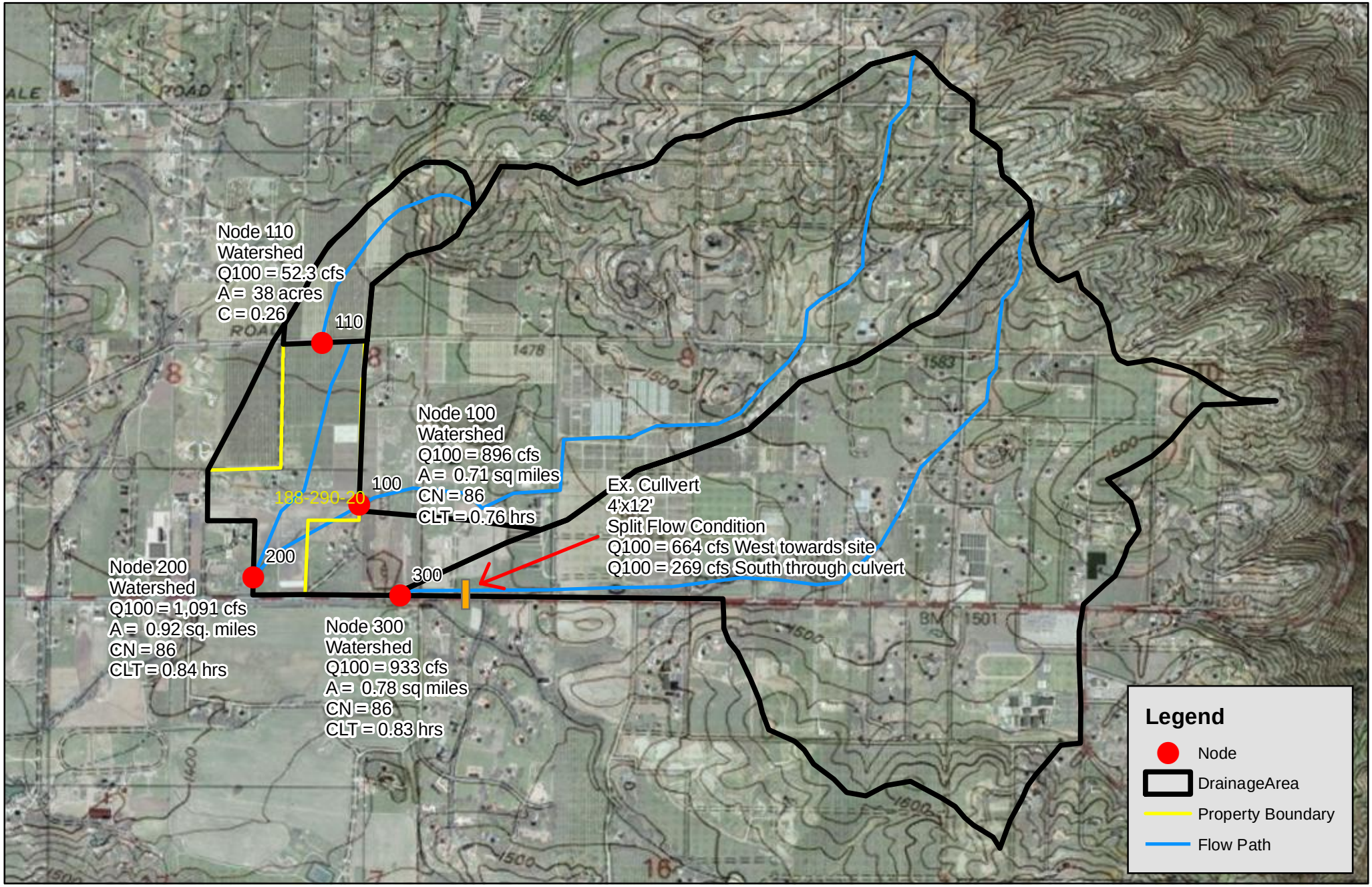
On site, immediately downstream of photo above (looking north from easterly project boundary)

Flow path across southerly portion of site (looking south westerly at the project site from the easterly project boundary)

Vesper Road – no curb and gutter (looking northerly from northerly project boundary)

Attachment C - Hydrologic Calculations

Hydrologic Work Maps



CN = Curve Number
CLT = Corps Lag Time

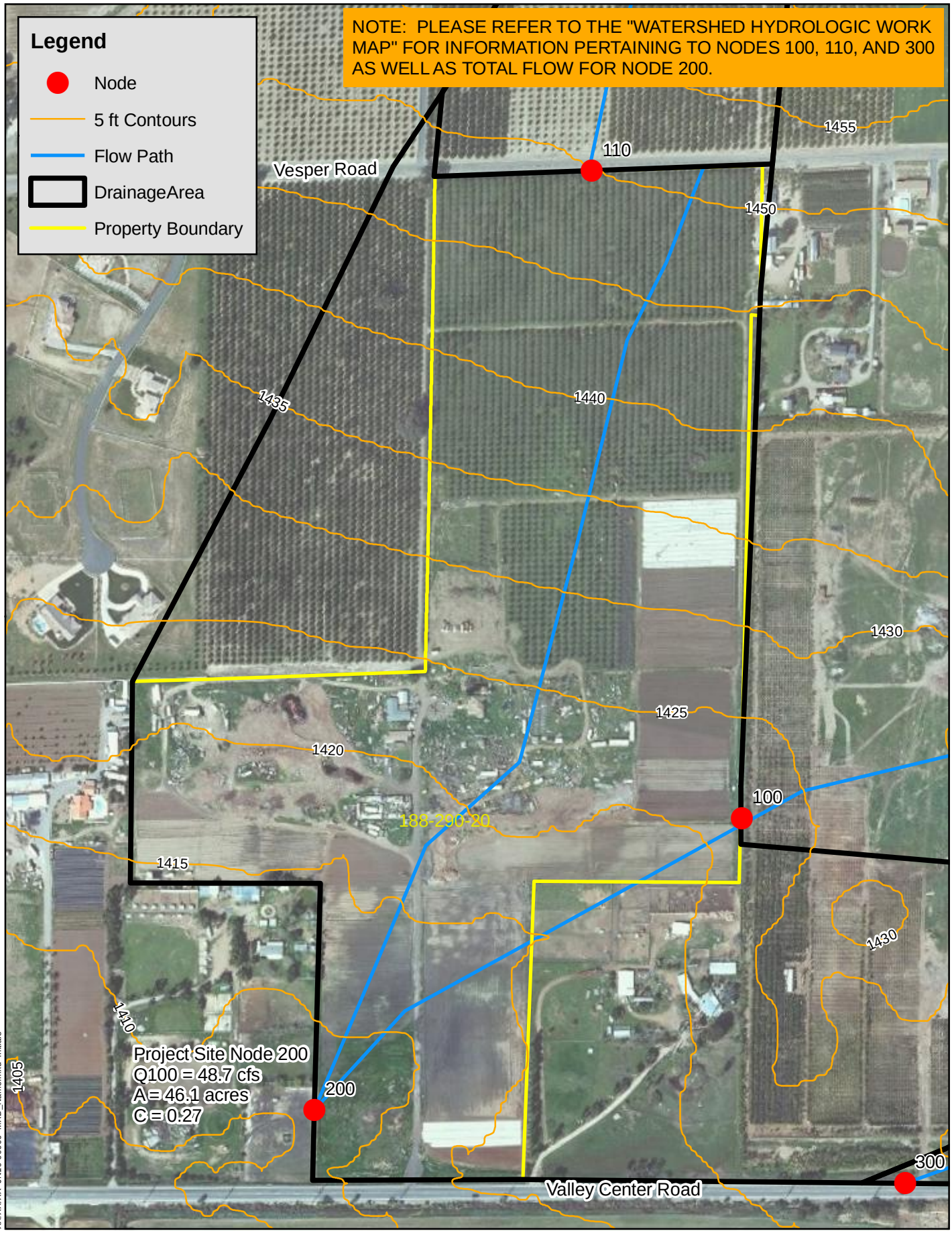
RBF CONSULTING GIS

Scale 1:16,000
Image: ESRI

File: M:\Mdata\25104980\GIS\003 Valley Center\4980 Valley Center Hydro Watershed.mxd
Date Created: 27 July 2011

SOL ORCHARD - VALLEY CENTER

WATERSHED HYDROLOGIC WORK MAP



XX/XX/XX JN10-00000 MXD_Name.mxd Initials

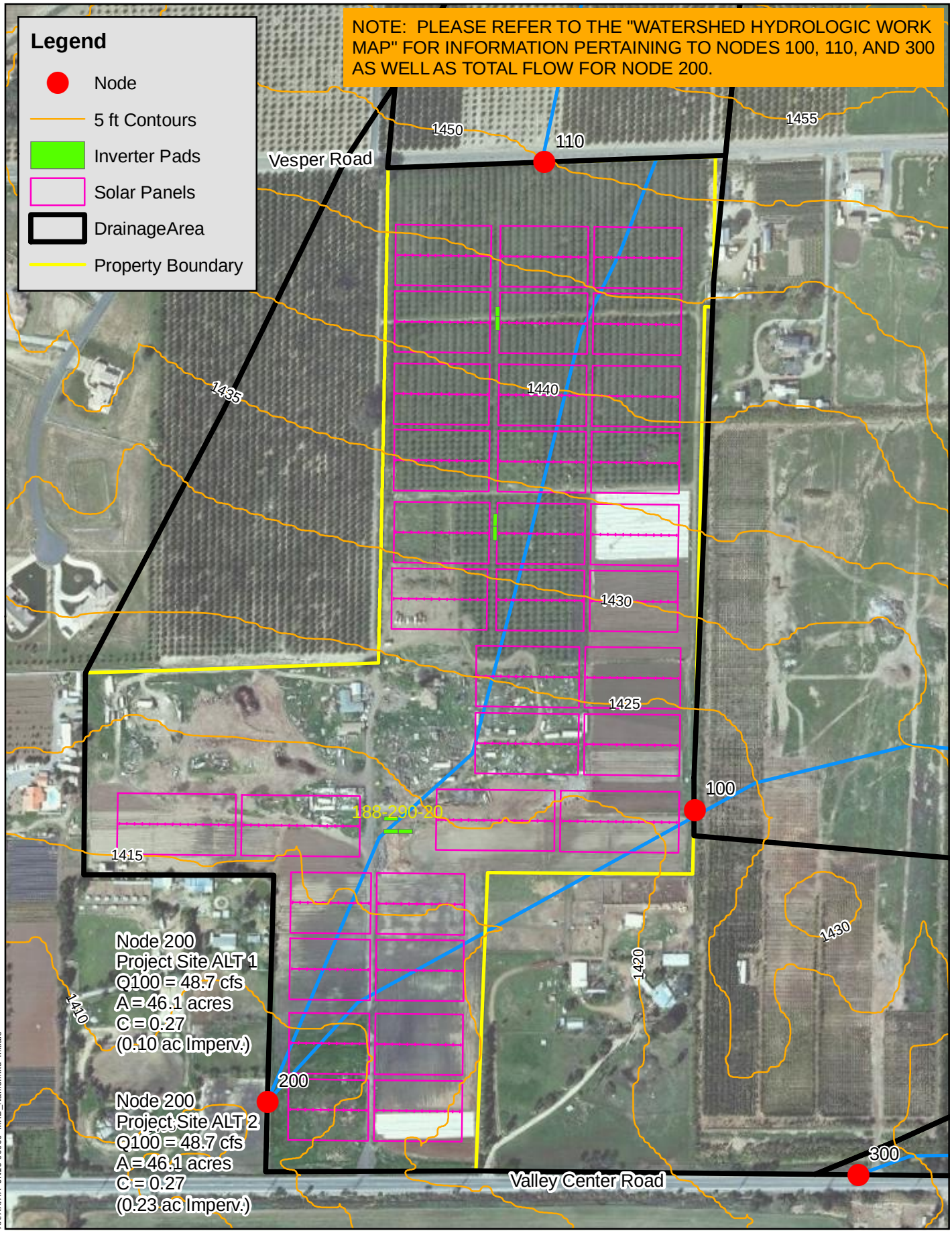
RBF CONSULTING GIS

0 125 250 500 Feet

Source:
Image: ESRI
Contours: Intermap

SOL ORCHARD - VALLEY CENTER

Project Site Existing Conditions
Hydrologic Work Map



XX/XX/XX JN10-00000 MXD_Name.mxd Initials

RBF CONSULTING GIS

0 125 250 500 Feet

Source:
Image: ESRI
Contours: Intermap

SOL ORCHARD - VALLEY CENTER

Project Site Proposed Conditions Hydrologic Work Map

Rational Method Analysis

Northerly Run-on

Node	Total Area (ac)	Weighted C	Rainfall		Initial Time of Concentration (Ti)					Travel Time (Tt)					Tc (min)	i (in/hr)	Q100 (cfs)
			P6, 100YR (in)	P24, 100YR (in)	US Elev (ft)	DS Elev (ft)	Length (ft)	Slope (%)	Ti (min)	US Elev (ft)	DS Elev (ft)	Length (ft)	Slope (%)	Tt (min)			
110	**38.0**	**0.26**	3.8	8.5	1625.00	1615.00	100	10.0%	5.0	1615.0	1450.0	2357	7.0%	9	13.6	**5.3**	**52.3**

Note:
1. Node 110 represents runo-on from a 38-acre watershed immedaitely north of the project site (Does not change between Pre and Post development).

Existing Condtion

Node	Total Area (ac)	Weighted C	Rainfall		Initial Time of Concentration (Ti)					Travel Time (Tt)					Tc (min)	i (in/hr)	Q100 (cfs)
			P6, 100YR (in)	P24, 100YR (in)	US Elev (ft)	DS Elev (ft)	Length (ft)	Slope (%)	Ti (min)	US Elev (ft)	DS Elev (ft)	Length (ft)	Slope (%)	Tt (min)			
200	**46.1**	**0.27**	3.8	8.5	1450.00	1445.00	100	5.0%	5.0	1445.0	1405.0	2582	1.5%	16	21.5	**3.9**	**48.7**

Unmitigated Proposed Condition: ALT 1

Node	Total Area (ac)	Weighted C	Rainfall		Initial Time of Concentration (Ti)					Travel Time (Tt)					Tc (min)	i (in/hr)	Q100 (cfs)
			P6, 100YR (in)	P24, 100YR (in)	US Elev (ft)	DS Elev (ft)	Length (ft)	Slope (%)	Ti (min)	US Elev (ft)	DS Elev (ft)	Length (ft)	Slope (%)	Tt (min)			
200	**46.1**	**0.27**	3.8	8.5	1450.00	1445.00	100	5.0%	5.0	1445.0	1405.0	2582	1.5%	16	21.5	**3.9**	**48.7**

Note:
1. Assumes 100% of solar panel supports are Driven H-Piles

Proposed Condition: ALT 2

Node	Total Area (ac)	Weighted C	Rainfall		Initial Time of Concentration (Ti)					Travel Time (Tt)					Tc (min)	i (in/hr)	Q100 (cfs)
			P6, 100YR (in)	P24, 100YR (in)	US Elev (ft)	DS Elev (ft)	Length (ft)	Slope (%)	Ti (min)	US Elev (ft)	DS Elev (ft)	Length (ft)	Slope (%)	Tt (min)			
200	**46.1**	**0.27**	3.8	8.5	1450.00	1445.00	100	5.0%	5.0	1445.0	1405.0	2582	1.5%	16	21.5	**3.9**	**48.7**

Note:
1. Assumes 10% of solar panel supports are ballast foundation system and 90% of solar panel supports are Driven H-Pile Posts

Notes:
1. Rainfall intensity (i) = 7.44*P6*Tc^-0.645 (SDCHM, p. 3-7)
2. Runoff coefficient (C) (SDCHM, Table 3-1 & SDCHM, p. 3-5)
3. Hydrologic Soil Group (SDCHM Appendix A)
4. Initial travel time (Ti) (SDCHM, Table 3-2)
5. Travel time calculated using Kirpich formula. (SDCHM, Figure 3-4)

Off-Site Rational

Land Use	110	
	Area	C
Type B Natural	29.0	0.25
Type C Natural	9.0	0.30
Total	**38.0**	
Weighted C		**0.26**

Project Site: Existing Condition

Land Use	Node 200	
	Area	C
Type B Natural	36.1	0.25
Type D Natural	10.0	0.35
Total	**46.1**	
Weighted C		**0.27**

Project Site: Proposed Condition: ALT 1

Land Use	Node 200	
	Area	C
Impervious (solar panel posts, inverters, etc.)	0.10	0.90
Type B, Natural Area	36.00	0.25
Type D, Natural Area	10.00	0.35
Total	**46.1**	
Weighted C		**0.27**

Project Site: Proposed Condition: ALT 2

Land Use	Node 200	
	Area	C
Impervious (solar panel posts, inverters, etc.)	0.23	0.90
Type B, Natural Area	35.87	0.25
Type D, Natural Area	10.00	0.35
Total	**46.1**	
Weighted C		**0.27**

Proposed Impervious

Driven H-Pile

Beam Section Used	Area (in^2)	Area (ft^2)
5" I-Beam	6.49	0.045

Ballasted Foundation

Length (ft)	Width (ft)	Area (ft^2)
12	1.5	18

Inverter / Transformer Platform

Length (ft)	Width (ft)	Area
36	11	396

Alternative 1: Driven H-Pile Posts

Description	Quantity	Unit	Area (SF)	Total (SF)
Inverter/Transformer Platform	7	LS	396	2,772
Driven H-Pile Footing 5" I-Beam	4,064	EA	0.0451	183
			TOTAL =	2,955

TOTAL IMPERVIOUS SURFACES = 0.1 AC

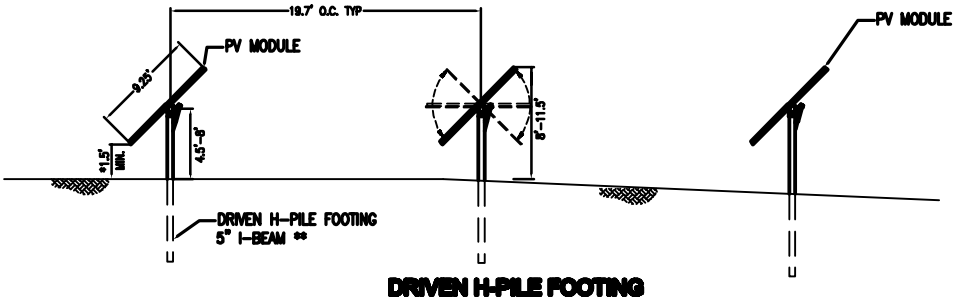
Alternative 2: Ballasted Foundation System (max 10%)

Description	Quantity	Unit	Area (SF)	Total (SF)	
Inverter/Transformer Platform	7	EA	396	2,772	*
Ballasted Foundation	405	EA	18	7,290	**
Driven H-Pile Footing 5" I-Beam	3,659	EA	0.0451	165	**
			TOTAL =	10,227	

TOTAL IMPERVIOUS SURFACES = 0.23 AC

As shown on the Preliminary Grading Plans:

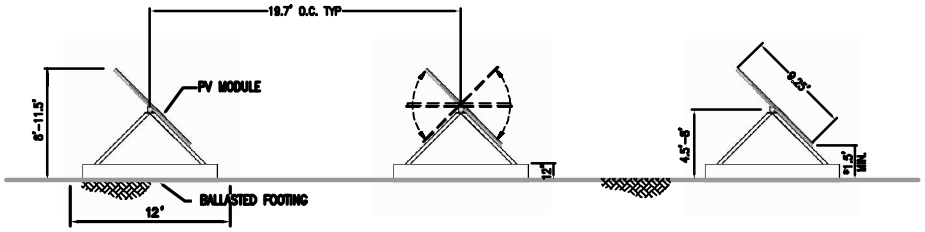
* Inverter / Transformer Platform 0.06 ac (2772 SF)
** Footing Foundation 0.17 ac (7,290 SF + 165 SF)



DRIVEN H-PILE FOOTING

POLE HEIGHTS MAY VARY TO FIT EXISTING TERRAIN (NO GRADING PROPOSED)

** DEPTH OF FOOTING TO BE DETERMINED BY STRUCTURAL ENGINEER



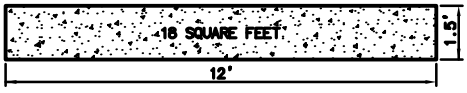
BALLASTED FOUNDATION

RACK FRAMING HEIGHTS MAY VARY TO FIT EXISTING TERRAIN (NO GRADING PROPOSED). SEE BALLAST FOOTING ALTERNATIVE BELOW.

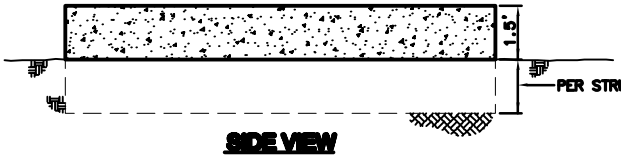
PROFILE VIEW
TRACKER ELEVATION W-E

N.T.S.

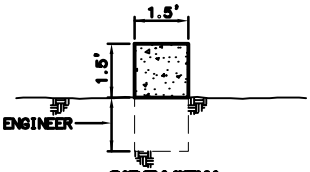
* NOTE: BOTTOM OF PANEL TO BE A MIN. 1' ABOVE BASE FLOOD ELEVATION (BFE)



TOP VIEW
N.T.S.



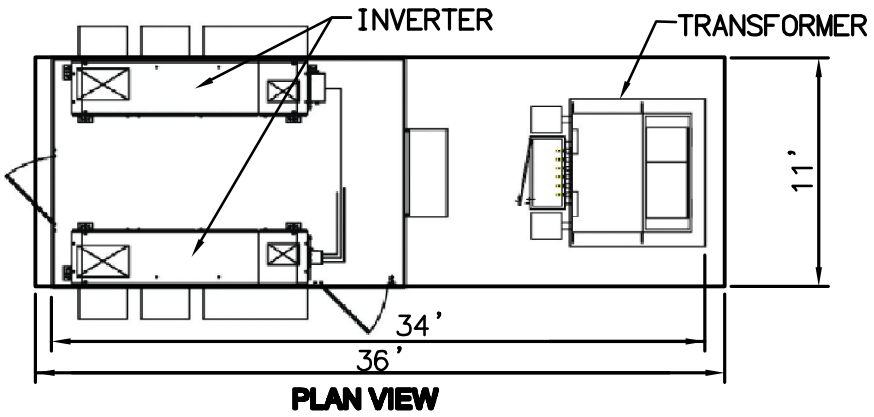
SIDE VIEW
N.T.S.



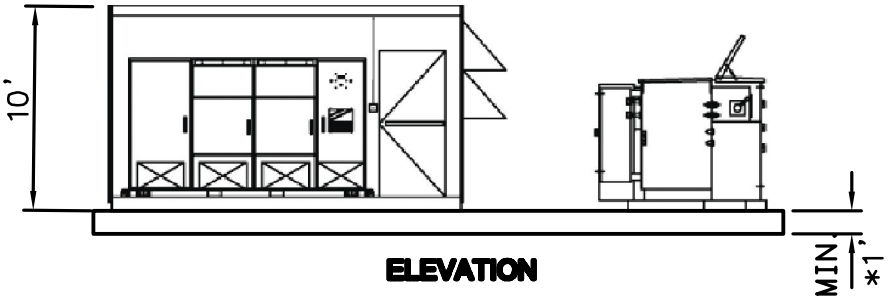
SIDE VIEW
N.T.S.

BALLAST FOOTING (ALTERNATIVE)

THE PROJECT'S STRUCTURAL ENGINEER, BASED ON EXISTING FIELD AND SOILS CONDITIONS, MAY RECOMMEND THE USE OF BALLASTED FOOTINGS IN LIEU OF THE TYPICAL DRIVEN H-PILE FOOTINGS. USE OF THE BALLASTED FOOTINGS IS LIMITED TO 10% (405) OF THE TOTAL NUMBER OF FOOTINGS. INDIVIDUAL OR SERIES OF BALLASTED FOOTINGS MAY BE INTERSPERSED WITHIN ROWS OF TYPICAL DRIVEN H-PILE FOOTINGS. SPACING OF BALLASTED FOOTINGS WILL MATCH INTERVALS AS SHOWN FOR THE TYPICAL DRIVEN H-PILE FOOTINGS.



PLAN VIEW



ELEVATION

INVERTER / TRANSFORMER PLATFORM

N.T.S.

* NOTE: INVERTER / TRANSFORMER FINISH FLOOR TO BE A MIN. 1' ABOVE BASE FLOOD ELEVATION (BFE)

- ALL ACCESSORY STRUCTURES SHALL BE PAINTED OR VISUALLY TREATED TO BLEND WITH THE SURROUNDINGS

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Off-Site Analysis: Peak Flow Generator

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**************************************************************************
******
  * The San Diego Unit Hydrograph (SDUH) Peak Discharge Program uses the
*
  * procedures described in Section 4 of the San Diego County Hydrology
*
  * Manual for NRCS Hydrologic Method calculations.  The SDUH Peak
Discharge   *
  * Program may be used only for determination of peak flow rate, and
may not  *
  * be used for detention basin design or other routing purposes for
which a   *
  * hydrograph is required.  To generate a hydrograph, the calculation
method  *
  * described in Section 4 of the San Diego County Hydrology Manual may
be     *
  * used, or a computer program that includes good documentation of the
*
  * calculations (see Section 1.7 of the San Diego County Hydrology
manual).   *
  * Note: the RATHYDRO computer program is not based on the calculation
method *
  * described in Section 4 of the San Diego County Hydrology Manual and
may    *
  * not be used to generate a hydrograph based on the SDUH Peak
Discharge      *
  * Program output.
*

**************************************************************************
******

   Project Identification: Valley Center Node 100: Watershed Run-On
   Storm Frequency (years) =  100
   Drainage Area (square miles) =    0.710
   6-Hour Rainfall (inches) =     3.80
   6-Hour Depth-Area Factor =    0.998
   24-Hour Rainfall (inches) =     8.50
   24-Hour Depth-Area Factor =    0.999
   Adjusted Curve Number = 86
   Unit Interval (minutes) =  5
   Watershed Lag Time (hours) =    0.760
   Peak Flow Rate (cfs) =      896.4
```

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*************************************************************************
******
  * The San Diego Unit Hydrograph (SDUH) Peak Discharge Program uses the
*
  * procedures described in Section 4 of the San Diego County Hydrology
*
  * Manual for NRCS Hydrologic Method calculations.  The SDUH Peak
Discharge   *
  * Program may be used only for determination of peak flow rate, and
may not  *
  * be used for detention basin design or other routing purposes for
which a   *
  * hydrograph is required.  To generate a hydrograph, the calculation
method  *
  * described in Section 4 of the San Diego County Hydrology Manual may
be     *
  * used, or a computer program that includes good documentation of the
*
  * calculations (see Section 1.7 of the San Diego County Hydrology
manual).   *
  * Note: the RATHYDRO computer program is not based on the calculation
method *
  * described in Section 4 of the San Diego County Hydrology Manual and
may    *
  * not be used to generate a hydrograph based on the SDUH Peak
Discharge      *
  * Program output.
*

*************************************************************************
******

   Project Identification: Valley Center Node 200: Watershed Run-Off
   Storm Frequency (years) =  100
   Drainage Area (square miles) =    0.920
   6-Hour Rainfall (inches) =     3.80
   6-Hour Depth-Area Factor =    0.997
   24-Hour Rainfall (inches) =     8.50
   24-Hour Depth-Area Factor =    0.998
   Adjusted Curve Number = 86
   Unit Interval (minutes) =  5
   Watershed Lag Time (hours) =    0.840
   Peak Flow Rate (cfs) =     1090.7
```

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*************************************************************************
******
  * The San Diego Unit Hydrograph (SDUH) Peak Discharge Program uses the
*
  * procedures described in Section 4 of the San Diego County Hydrology
*
  * Manual for NRCS Hydrologic Method calculations.  The SDUH Peak
Discharge   *
  * Program may be used only for determination of peak flow rate, and
may not  *
  * be used for detention basin design or other routing purposes for
which a   *
  * hydrograph is required.  To generate a hydrograph, the calculation
method  *
  * described in Section 4 of the San Diego County Hydrology Manual may
be     *
  * used, or a computer program that includes good documentation of the
*
  * calculations (see Section 1.7 of the San Diego County Hydrology
manual).   *
  * Note: the RATHYDRO computer program is not based on the calculation
method *
  * described in Section 4 of the San Diego County Hydrology Manual and
may    *
  * not be used to generate a hydrograph based on the SDUH Peak
Discharge      *
  * Program output.
*

*************************************************************************
******

   Project Identification: Valley Center Node 300: Watershed Split Flow
   Storm Frequency (years) =  100
   Drainage Area (square miles) =    0.780
   6-Hour Rainfall (inches) =     3.80
   6-Hour Depth-Area Factor =    0.998
   24-Hour Rainfall (inches) =     8.50
   24-Hour Depth-Area Factor =    0.998
   Adjusted Curve Number = 86
   Unit Interval (minutes) =  5
   Watershed Lag Time (hours) =    0.830
   Peak Flow Rate (cfs) =      933.1
```

Valley Center (25-104980.003)

LANDUSE SanDAG	Cover Description (from Table 4-2, SDCHM)	Soil Type Soil Survey	CN PZN = 2.0	Area (acres)	CN * Area
Field Crops	Row Crops (Straight Row, Good)	B	78	46.0	3591.7
Field Crops	Row Crops (Straight Row, Good)	B	78	3.1	238.5
Field Crops	Row Crops (Straight Row, Good)	B	78	0.5	39.2
Field Crops	Row Crops (Straight Row, Good)	B	78	0.1	10.0
Field Crops	Row Crops (Straight Row, Good)	B	78	2.2	170.8
Field Crops	Row Crops (Straight Row, Good)	B	78	1.9	145.8
Field Crops	Row Crops (Straight Row, Good)	B	78	5.6	440.6
Field Crops	Row Crops (Straight Row, Good)	B	78	6.8	527.6
Field Crops	Row Crops (Straight Row, Good)	B	78	25.3	1975.7
Field Crops	Row Crops (Straight Row, Good)	B	78	5.9	458.1
Field Crops	Row Crops (Straight Row, Good)	B	78	1.6	128.1
Field Crops	Row Crops (Straight Row, Good)	B	78	0.2	12.8
Field Crops	Row Crops (Straight Row, Good)	B	78	18.7	1459.7
Field Crops	Row Crops (Straight Row, Good)	B	78	2.0	158.7
Field Crops	Row Crops (Straight Row, Good)	B	78	0.8	64.4
Field Crops	Row Crops (Straight Row, Good)	B	78	2.0	153.7
Field Crops	Row Crops (Straight Row, Good)	B	78	5.2	405.0
Field Crops	Row Crops (Straight Row, Good)	B	78	1.3	98.3
Field Crops	Row Crops (Straight Row, Good)	D	89	11.3	1008.0
Field Crops	Row Crops (Straight Row, Good)	D	89	13.1	1164.5
Field Crops	Row Crops (Straight Row, Good)	D	89	1.9	165.1
Intensive Agriculture	Row Crops (Straight Row, Poor)	B	81	6.1	495.6
Intensive Agriculture	Row Crops (Straight Row, Poor)	B	81	4.6	375.5
Intensive Agriculture	Row Crops (Straight Row, Poor)	B	81	8.9	723.0
Junior High School or Middle School	Urban Districts (Commercial & Business)	B	92	0.5	48.1
Junior High School or Middle School	Urban Districts (Commercial & Business)	B	92	5.5	503.8
Junior High School or Middle School	Urban Districts (Commercial & Business)	B	92	17.7	1632.1
Junior High School or Middle School	Urban Districts (Commercial & Business)	D	95	9.4	895.9
Orchard or Vineyard	Orchards (Fair)	B	65	0.0	0.5
Orchard or Vineyard	Orchards (Fair)	B	65	4.8	314.7
Orchard or Vineyard	Orchards (Fair)	B	65	8.8	570.6
Orchard or Vineyard	Orchards (Fair)	B	65	38.3	2491.3
Orchard or Vineyard	Orchards (Fair)	B	65	2.6	171.2

Valley Center (25-104980.003)

LANDUSE SanDAG	Cover Description (from Table 4-2, SDCHM)	Soil Type Soil Survey	CN PZN = 2.0	Area (acres)	CN * Area
Orchard or Vineyard	Orchards (Fair)	B	65	11.2	728.1
Orchard or Vineyard	Orchards (Fair)	B	65	1.0	66.5
Orchard or Vineyard	Orchards (Fair)	B	65	0.9	59.5
Orchard or Vineyard	Orchards (Fair)	B	65	2.3	146.7
Orchard or Vineyard	Orchards (Fair)	B	65	11.0	712.8
Orchard or Vineyard	Orchards (Fair)	B	65	6.8	444.4
Orchard or Vineyard	Orchards (Fair)	B	65	4.3	279.9
Orchard or Vineyard	Orchards (Fair)	B	65	2.6	167.9
Orchard or Vineyard	Orchards (Fair)	B	65	2.5	164.2
Orchard or Vineyard	Orchards (Fair)	B	65	35.7	2320.4
Orchard or Vineyard	Orchards (Fair)	B	65	5.5	359.7
Orchard or Vineyard	Orchards (Fair)	B	65	1.8	115.8
Orchard or Vineyard	Orchards (Fair)	B	65	21.3	1387.1
Orchard or Vineyard	Orchards (Fair)	B	65	0.1	5.9
Orchard or Vineyard	Orchards (Fair)	B	65	1.1	69.2
Orchard or Vineyard	Orchards (Fair)	B	65	0.2	13.7
Orchard or Vineyard	Orchards (Fair)	B	65	0.2	16.0
Orchard or Vineyard	Orchards (Fair)	B	65	0.5	32.2
Orchard or Vineyard	Orchards (Fair)	B	65	0.7	43.1
Orchard or Vineyard	Orchards (Fair)	B	65	0.3	22.0
Orchard or Vineyard	Orchards (Fair)	B	65	6.5	420.4
Orchard or Vineyard	Orchards (Fair)	B	65	1.3	82.9
Orchard or Vineyard	Orchards (Fair)	B	65	0.3	19.3
Orchard or Vineyard	Orchards (Fair)	B	65	0.8	54.3
Orchard or Vineyard	Orchards (Fair)	B	65	0.1	5.1
Orchard or Vineyard	Orchards (Fair)	B	65	4.9	318.0
Orchard or Vineyard	Orchards (Fair)	B	65	0.2	10.3
Orchard or Vineyard	Orchards (Fair)	B	65	1.2	77.4
Orchard or Vineyard	Orchards (Fair)	B	65	36.7	2387.5
Orchard or Vineyard	Orchards (Fair)	B	65	10.5	682.6
Orchard or Vineyard	Orchards (Fair)	B	65	5.8	376.9
Orchard or Vineyard	Orchards (Fair)	B	65	25.7	1669.7
Orchard or Vineyard	Orchards (Fair)	C	77	0.0	2.0

Valley Center (25-104980.003)

LANDUSE SanDAG	Cover Description (from Table 4-2, SDCHM)	Soil Type Soil Survey	CN PZN = 2.0	Area (acres)	CN * Area
Orchard or Vineyard	Orchards (Fair)	C	77	1.2	94.0
Orchard or Vineyard	Orchards (Fair)	C	77	0.1	4.6
Orchard or Vineyard	Orchards (Fair)	C	77	8.0	617.0
Orchard or Vineyard	Orchards (Fair)	C	77	2.2	172.7
Orchard or Vineyard	Orchards (Fair)	C	77	0.6	43.3
Orchard or Vineyard	Orchards (Fair)	D	82	2.0	165.9
Orchard or Vineyard	Orchards (Fair)	D	82	0.3	26.5
Other Retail Trade and Strip	Urban Districts (Commercial & Business)	B	92	2.5	225.9
Religious Facility	Urban Districts (Commercial & Business)	B	92	1.1	99.7
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	1.0	87.9
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	0.6	49.1
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	5.0	444.3
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	2.1	186.7
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	3.8	341.8
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	1.8	159.9
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	1.3	115.4
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	0.3	22.9
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	1.4	125.6
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	0.2	22.0
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	1.8	156.9
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	4.3	380.0
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	0.1	8.7
Road Right of Way	Streets and Roads (Paved, Open Ditch)	B	89	0.2	21.2
Road Right of Way	Streets and Roads (Paved, Open Ditch)	C	92	0.1	13.1
Road Right of Way	Streets and Roads (Paved, Open Ditch)	D	93	0.1	7.1
Road Right of Way	Streets and Roads (Paved, Open Ditch)	D	93	1.5	138.8
Spaced Rural Residential	Residential (2 acres)	B	65	0.8	53.8
Spaced Rural Residential	Residential (2 acres)	B	65	3.2	209.8
Spaced Rural Residential	Residential (2 acres)	B	65	0.7	47.2
Spaced Rural Residential	Residential (2 acres)	B	65	1.6	103.0
Spaced Rural Residential	Residential (2 acres)	B	65	8.3	538.5
Spaced Rural Residential	Residential (2 acres)	B	65	10.3	667.7
Spaced Rural Residential	Residential (2 acres)	B	65	0.6	36.0

Valley Center (25-104980.003)

LANDUSE SanDAG	Cover Description (from Table 4-2, SDCHM)	Soil Type Soil Survey	CN PZN = 2.0	Area (acres)	CN * Area
Spaced Rural Residential	Residential (2 acres)	B	65	12.5	811.2
Spaced Rural Residential	Residential (2 acres)	B	65	12.6	821.0
Spaced Rural Residential	Residential (2 acres)	B	65	8.0	520.4
Spaced Rural Residential	Residential (2 acres)	B	65	2.9	185.5
Spaced Rural Residential	Residential (2 acres)	B	65	6.8	444.3
Spaced Rural Residential	Residential (2 acres)	B	65	13.4	873.0
Spaced Rural Residential	Residential (2 acres)	B	65	76.1	4948.5
Spaced Rural Residential	Residential (2 acres)	B	65	0.1	3.3
Spaced Rural Residential	Residential (2 acres)	B	65	0.0	0.4
Spaced Rural Residential	Residential (2 acres)	B	65	2.0	130.8
Spaced Rural Residential	Residential (2 acres)	B	65	5.8	380.2
Spaced Rural Residential	Residential (2 acres)	B	65	6.8	439.6
Spaced Rural Residential	Residential (2 acres)	B	65	4.9	315.6
Spaced Rural Residential	Residential (2 acres)	B	65	25.1	1634.0
Spaced Rural Residential	Residential (2 acres)	B	65	2.2	146.2
Spaced Rural Residential	Residential (2 acres)	B	65	18.9	1231.0
Spaced Rural Residential	Residential (2 acres)	B	65	0.9	58.9
Spaced Rural Residential	Residential (2 acres)	B	65	8.3	536.9
Spaced Rural Residential	Residential (2 acres)	B	65	3.9	254.7
Spaced Rural Residential	Residential (2 acres)	B	65	48.5	3155.4
Spaced Rural Residential	Residential (2 acres)	B	65	7.7	501.2
Spaced Rural Residential	Residential (2 acres)	B	65	23.2	1507.0
Spaced Rural Residential	Residential (2 acres)	B	65	37.5	2437.8
Spaced Rural Residential	Residential (2 acres)	B	65	14.9	970.7
Spaced Rural Residential	Residential (2 acres)	C	77	19.5	1503.1
Spaced Rural Residential	Residential (2 acres)	C	77	70.7	5442.2
Spaced Rural Residential	Residential (2 acres)	C	77	24.9	1920.8
Spaced Rural Residential	Residential (2 acres)	C	77	8.4	647.3
Spaced Rural Residential	Residential (2 acres)	C	77	4.7	362.5
Spaced Rural Residential	Residential (2 acres)	C	77	0.7	55.4
Spaced Rural Residential	Residential (2 acres)	D	82	7.3	595.1
Spaced Rural Residential	Residential (2 acres)	D	82	2.2	180.0
Spaced Rural Residential	Residential (2 acres)	D	82	0.5	37.9

Valley Center (25-104980.003)

LANDUSE SanDAG	Cover Description (from Table 4-2, SDCHM)	Soil Type Soil Survey	CN PZN = 2.0	Area (acres)	CN * Area
Spaced Rural Residential	Residential (2 acres)	D	82	23.4	1917.9
Spaced Rural Residential	Residential (2 acres)	D	82	15.7	1290.4
Vacant and Undeveloped Land	Open Brush (Fair)	B	66	4.7	309.8
Vacant and Undeveloped Land	Open Brush (Fair)	B	66	0.9	61.2
Vacant and Undeveloped Land	Open Brush (Fair)	B	66	0.6	36.9
Vacant and Undeveloped Land	Open Brush (Fair)	B	66	0.2	14.8
Vacant and Undeveloped Land	Open Brush (Fair)	B	66	4.1	272.1
Vacant and Undeveloped Land	Open Brush (Fair)	B	66	4.0	263.5
Vacant and Undeveloped Land	Open Brush (Fair)	B	66	1.5	101.7
Vacant and Undeveloped Land	Open Brush (Fair)	B	66	1.8	117.8
Vacant and Undeveloped Land	Open Brush (Fair)	B	66	8.0	527.9
Vacant and Undeveloped Land	Open Brush (Fair)	C	77	3.1	235.2
Vacant and Undeveloped Land	Open Brush (Fair)	C	77	1.7	129.8
Vacant and Undeveloped Land	Open Brush (Fair)	C	77	0.2	12.0
Vacant and Undeveloped Land	Open Brush (Fair)	C	77	0.2	18.0

Sum	**1088.148**	**77648.5**
Average CN for PZN = 2.0		**71**
Basin PZN		**2.5**
Per Table 4-6, "Greater than or equal to a 35-year retrun period" : Adjusted PNZ		**3**
Adjusted CN		**86**

WATERSHED RUN-ON: NODE 100

From San Diego County Hydrology Manual, Equation 4-17 (page 4-34)

Corps T_1 (hours) =

$$T_1 = 24 * n * (\frac{L * L_C)}{s^{0.5}})^m$$

Where:

L =	1.7	Length to the longest watercourse (miles)
Lc =	0.82	Length along the longest watercourse, measured upstream to a point opposite the watershed centriod (miles)
s =	182	overall slope of drainage area between the headwaters and the collection point (feet per mile)
m =	0.38	a constant determined by regional flood reconstitution studies (0.38 for San Diego)
n =	0.075	the average of the Manning's n values of the watercourse and it's tributaries
T_1 =	0.76	hours
	46	minutes

WATERSHED RUN-OFF: NODE 200

From San Diego County Hydrology Manual, Equation 4-17 (page 4-34)

Corps T_1 (hours) =

$$T_1 = 24 * n * (\frac{L * L_C)}{s^{0.5}})^m$$

Where:

L =	1.96	Length to the longest watercourse (miles)
Lc =	0.86	Length along the longest watercourse, measured upstream to a point opposite the watershed centriod (miles)
s =	153	overall slope of drainage area between the headwaters and the collection point (feet per mile)
m =	0.38	a constant determined by regional flood reconstitution studies (0.38 for San Diego)
n =	0.075	the average of the Manning's n values of the watercourse and it's tributaries
T_1 =	0.84	hours
	51	minutes

WATERSHED (off-site): NODE 300

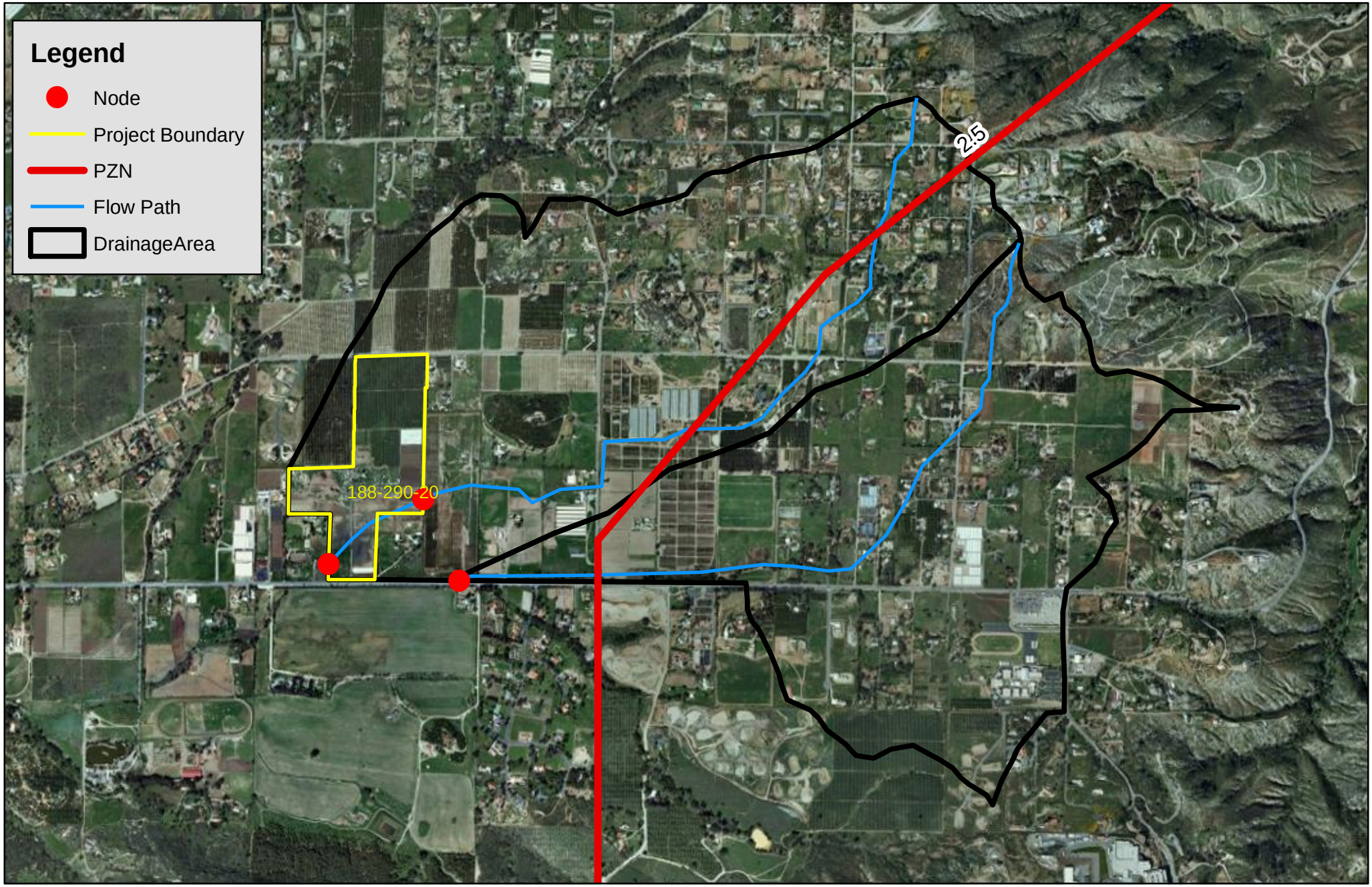
From San Diego County Hydrology Manual, Equation 4-17 (page 4-34)

Corps T_1 (hours) =

$$T_1 = 24 * n * (\frac{L * L_C)}{s^{0.5}})^m$$

Where:

L =	1.70	Length to the longest watercourse (miles)
Lc =	1.00	Length along the longest watercourse, measured upstream to a point opposite the watershed centriod (miles)
s =	165	overall slope of drainage area between the headwaters and the collection point (feet per mile)
m =	0.38	a constant determined by regional flood reconstitution studies (0.38 for San Diego)
n =	0.075	the average of the Manning's n values of the watercourse and it's tributaries
T_1 =	0.83	hours
	50	minutes



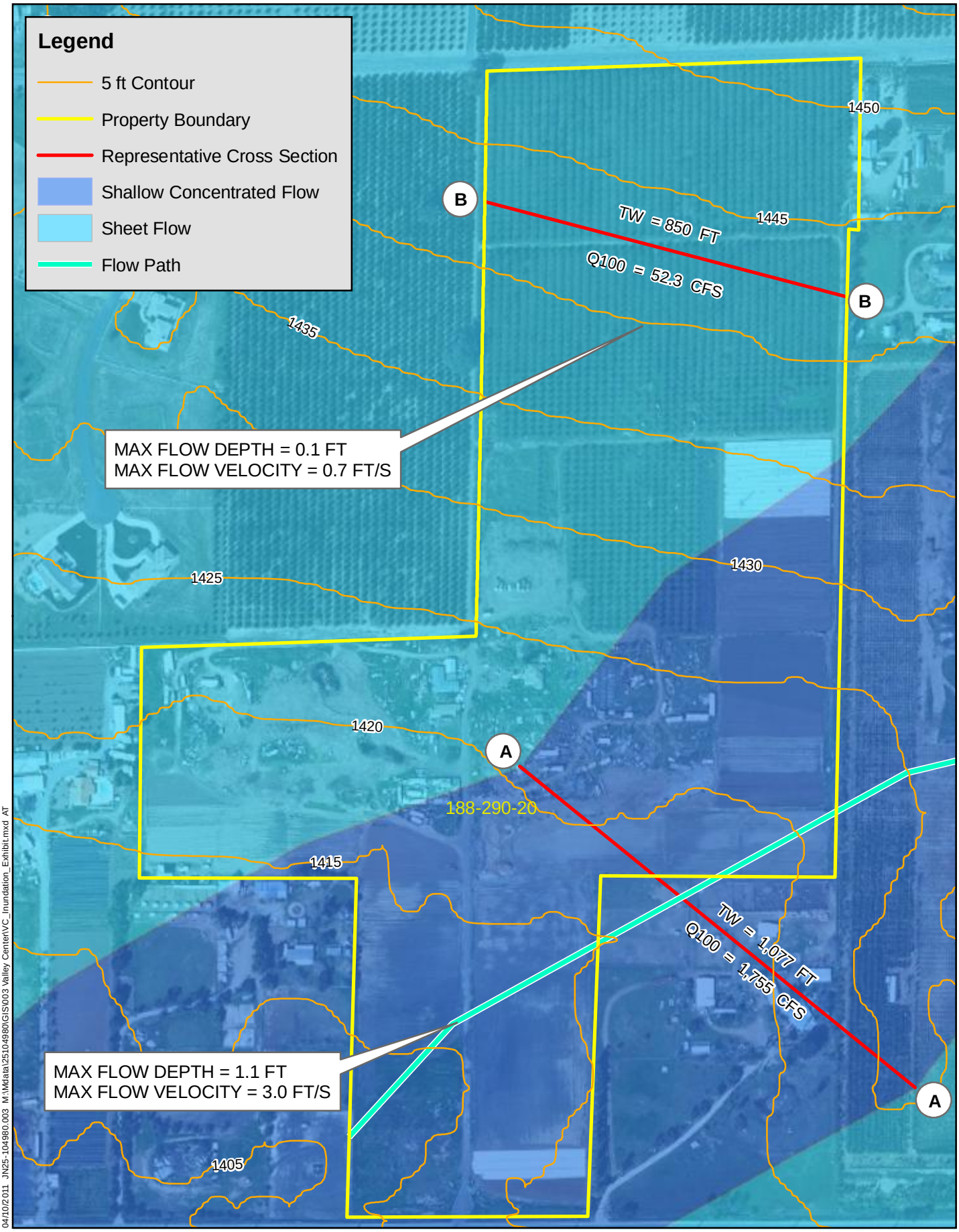
RBF CONSULTING GIS

Scale 1:18,000
Image: ESRI

Valley Center

PZN MAP

Attachment D - Hydraulic Calculations



04/10/2011 JN25-104980.003 M:\Mdata\25104980\GIS\003 Valley Center\VC_Inundation_Exhibit.mxd AT

RBF CONSULTING GIS

0 125 250 500 Feet

Source:
Image: ESRI
Contours: Intermap

SOL ORCHARD - VALLEY CENTER

Project Site Inundation Map

Flow Master

Cross Section A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.023	
Channel Slope	0.00500	ft/ft
Left Side Slope	500.00	ft/ft (H:V)
Right Side Slope	500.00	ft/ft (H:V)
Discharge	1755.00	ft^3/s

Results

Normal Depth	1.08	ft
Flow Area	580.12	ft^2
Wetted Perimeter	1077.14	ft
Top Width	1077.14	ft
Critical Depth	0.95	ft
Critical Slope	0.00989	ft/ft
Velocity	3.03	ft/s
Velocity Head	0.14	ft
Specific Energy	1.22	ft
Froude Number	0.73	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.08	ft
Critical Depth	0.95	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00989	ft/ft

Cross Section A

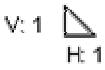
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.023	
Channel Slope	0.00500	ft/ft
Normal Depth	1.08	ft
Left Side Slope	500.00	ft/ft (H:V)
Right Side Slope	500.00	ft/ft (H:V)
Discharge	1755.00	ft³/s

Cross Section Image



Cross Section B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Bottom Width	850.00	ft
Discharge	52.30	ft^3/s

Results

Normal Depth	0.09	ft
Flow Area	75.14	ft^2
Wetted Perimeter	850.18	ft
Top Width	850.00	ft
Critical Depth	0.05	ft
Critical Slope	0.03581	ft/ft
Velocity	0.70	ft/s
Velocity Head	0.01	ft
Specific Energy	0.10	ft
Froude Number	0.41	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.09	ft
Critical Depth	0.05	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.03581	ft/ft

Cross Section B

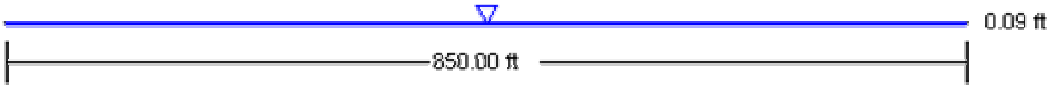
Project Description

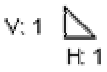
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00500	ft/ft
Normal Depth	0.09	ft
Bottom Width	850.00	ft
Discharge	52.30	ft³/s

Cross Section Image





Culvert Master

Culvert Analysis Report
Culvert-1

Culvert Summary					
Computed Headwater Eleva	121.28	ft	Discharge	1,150.00	cfs
Inlet Control HW Elev.	121.28	ft	Tailwater Elevation	N/A	ft
Outlet Control HW Elev.	115.29	ft	Control Type	Inlet Control	
Headwater Depth/Height	5.32				

Grades					
Upstream Invert	100.00	ft	Downstream Invert	99.56	ft
Length	40.00	ft	Constructed Slope	0.011000	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	4.00	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	4.00	ft
Velocity Downstream	23.96	ft/s	Critical Slope	0.025587	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	12.00	ft
Section Size	12 x 4 ft		Rise	4.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	115.29	ft	Upstream Velocity Head	8.92	ft
Ke	0.20		Entrance Loss	1.78	ft

Inlet Control Properties					
Inlet Control HW Elev.	121.28	ft	Flow Control	Submerged	
Inlet Type	90° headwall w 45° bevels		Area Full	48.0	ft2
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Rating Table Report
Culvert-1

Range Data:			
	Minimum	Maximum	Increment
Allowable HW E	100.00	104.00	1.00 ft

HW Elev. (ft)	Discharge (cfs)
100.00	0.00
101.00	33.63
102.00	95.13
103.00	174.76
104.00	269.06

Approximately 269 cfs is conveyed through the existing 4' x 12' culvert. The remaining Q100 at Node 300 (664 cfs) is added to Q100 at Node 200 as a conservative approximation of the total flow across the southerly portion of the site during the 100-year storm event

Valley Center
Universal Soil Loss
RBF JN: 25-104980.003

Universal Soil Loss Equation

From San Diego County Hydrology Manual, page 5-7

$$A_S = R * K * Ls * C * P$$

Where:

R =	80	rainfall erosion index for the given storm period
K =	0.23	soil erodibility factor
Ls =	0.17	slope length factor
C =	0.038	cropping management (vegetation) factor
P =	1	erosion control practice factor
As =	0.12	soil loss in tons (dry weight)

R

See Figure 5-2 from SDCHM, included herein

P(2)6 =	1.7	in
I =	1.75	in/hr (2-year, 6-hour intensity)
R =	80	

K

NRCS Web-Soil Survey

Soil	K	Percent
Co	0.2	15
PfC	0.32	4
VaA	0.17	81

Weighted K Factor = 0.18

SDCHM

Soil	K	Percent
Co	0.24	15
PfC	0.32	4
VaA	0.28	81

Weighted K Factor = 0.28

Ls

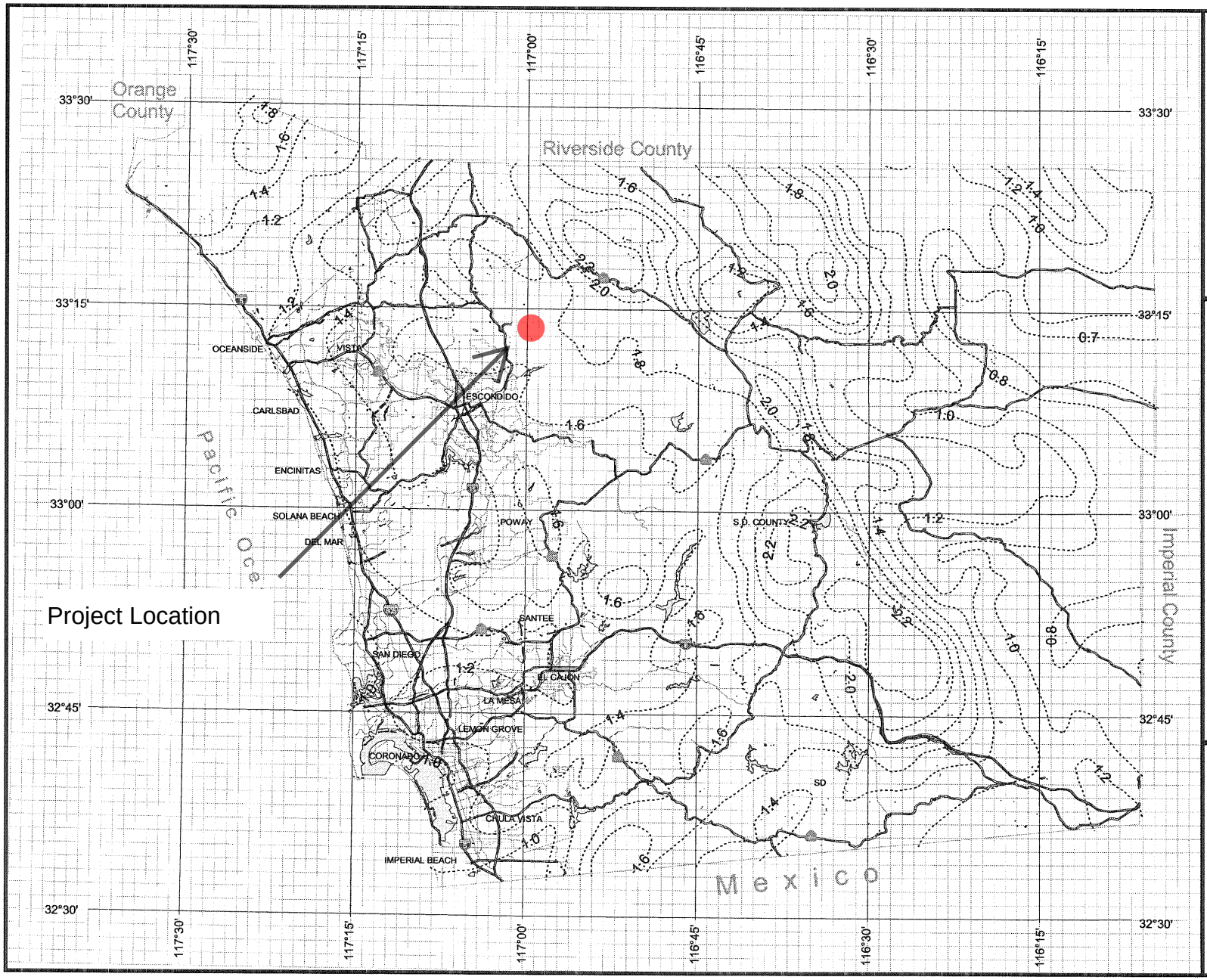
See Figure 5-5 from SDCHM, included herein
Ls =0.17

C

See Table 5-3 from SDCHM, included herein
Canopy of Tall Weeds
75% Canopy Cover
W: Broadleaf herbaceous plants
80% ground cover
C = 0.038

P

See Table 5-6 from SDCHM, included herein
Soil Sealant
P = 1



County of San Diego Hydrology Manual

Rainfall Isopluvials

2 Year Rainfall Event - 6 Hours

Isopluvial (inches)

P(2)6 = 1.7 in

DPW GIS
Department of Public Works Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles

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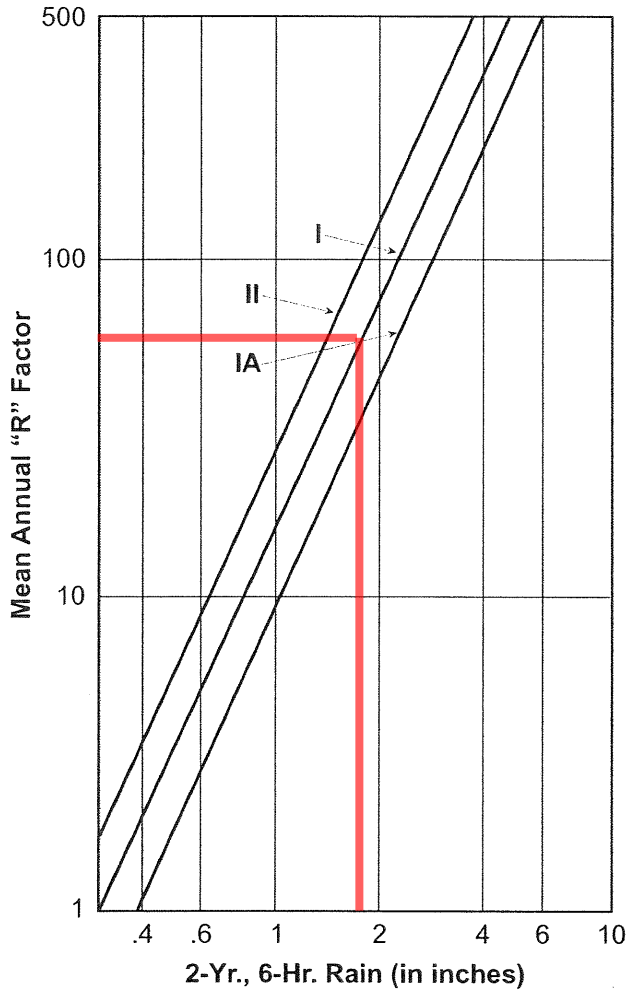
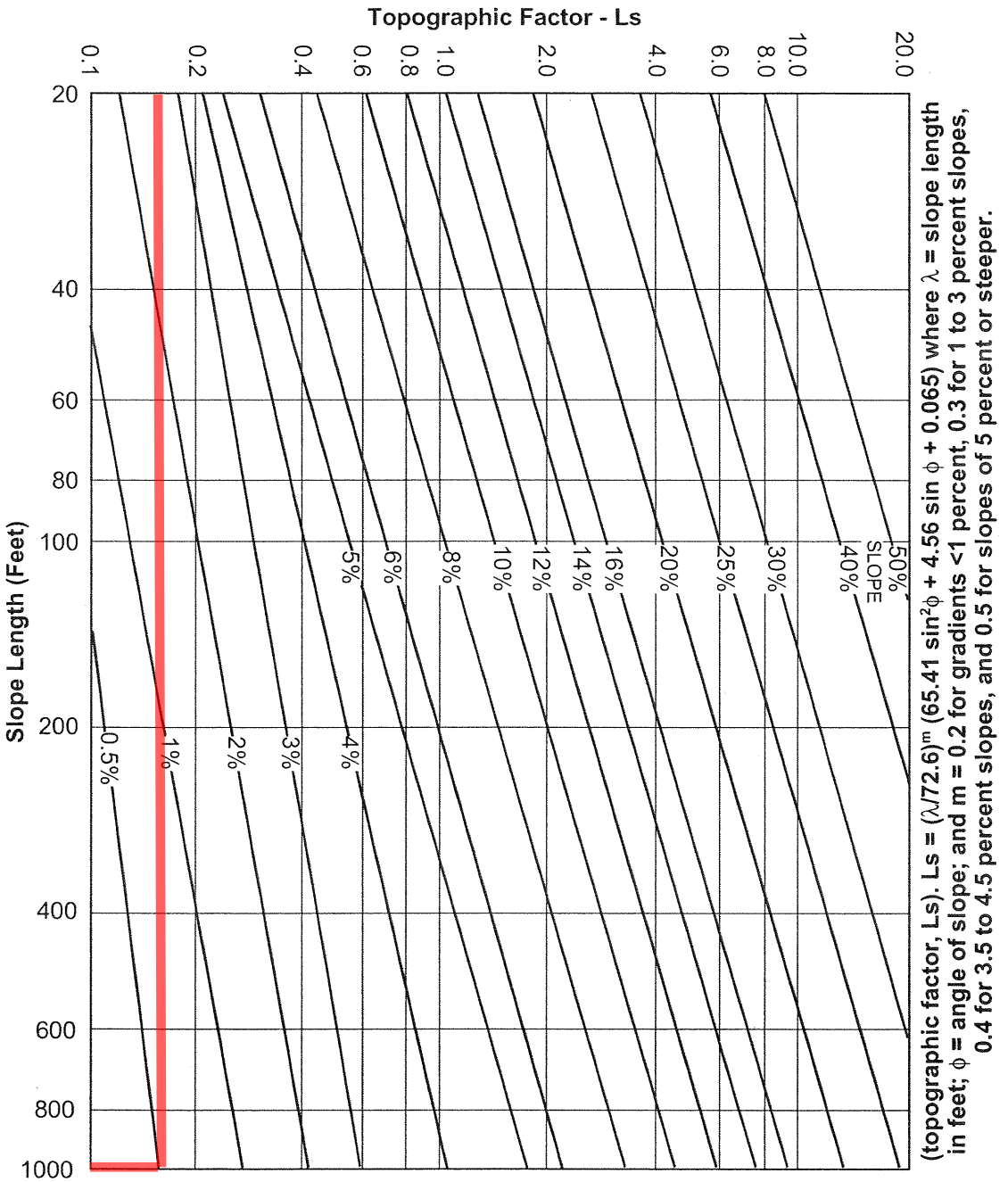


SOURCE: Wischmeier, 1977

FIGURE

R Factors based on 2-Year, 6-Hour Storm Event (Intensity)

5-2



SOURCE: SEA, USDA, Agricultural Handbook Number 537, December 1978

FIGURE

Chart for determining Topographic Factors (L,s)

5-5

Table 5-3

C FACTORS FOR PASTURE, RANGELAND, AND IDLE GROUND[1]

Vegetal Canopy			Cover That Contacts the Surface					
Type and Height of Raised Canopy[2]	Canopy Cover[3] %	Type[4]	Percent Ground Cover					
			0	20	40	60	80	95-100
Column No.:	2	3	4	5	6	7	8	9
No appreciable canopy		G	.45	.20	.10	.042	.013	.003
		W	.45	.24	.15	.090	.043	.011
Canopy of tall weeds or short brush (0.5 m fall ht.)	25	G	.36	.17	.09	.038	.012	.003
		W	.36	.20	.13	.082	.041	.011
	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.075	.039	.011
	75	G	.17	.10	.06	.031	.011	.003
		W	.17	.12	.09	.067	.038	.011
Appreciable brush or brushes (2 m fall ht.)	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.085	.042	.011
	50	G	.34	.16	.085	.038	.012	.003
		W	.34	.19	.13	.081	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.077	.041	.011
Trees but no appreciable low brush (4 m fall ht.)	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.087	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.085	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.083	.041	.011

Source: Gray and Leiser 1982.

[1] All values shown assume (1) random distribution or mulch or vegetation, and (2) mulch of appreciable depth where it exists.
[2] Average fall height of waterdrops from canopy to soil surface: m = meters.
[3] Portion of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).
[4] G: Cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 inches deep.
W: Cover at surface is mostly broadleaf herbaceous plants (as weeds) with little lateral-root network near the surface, and/or undecayed residue.

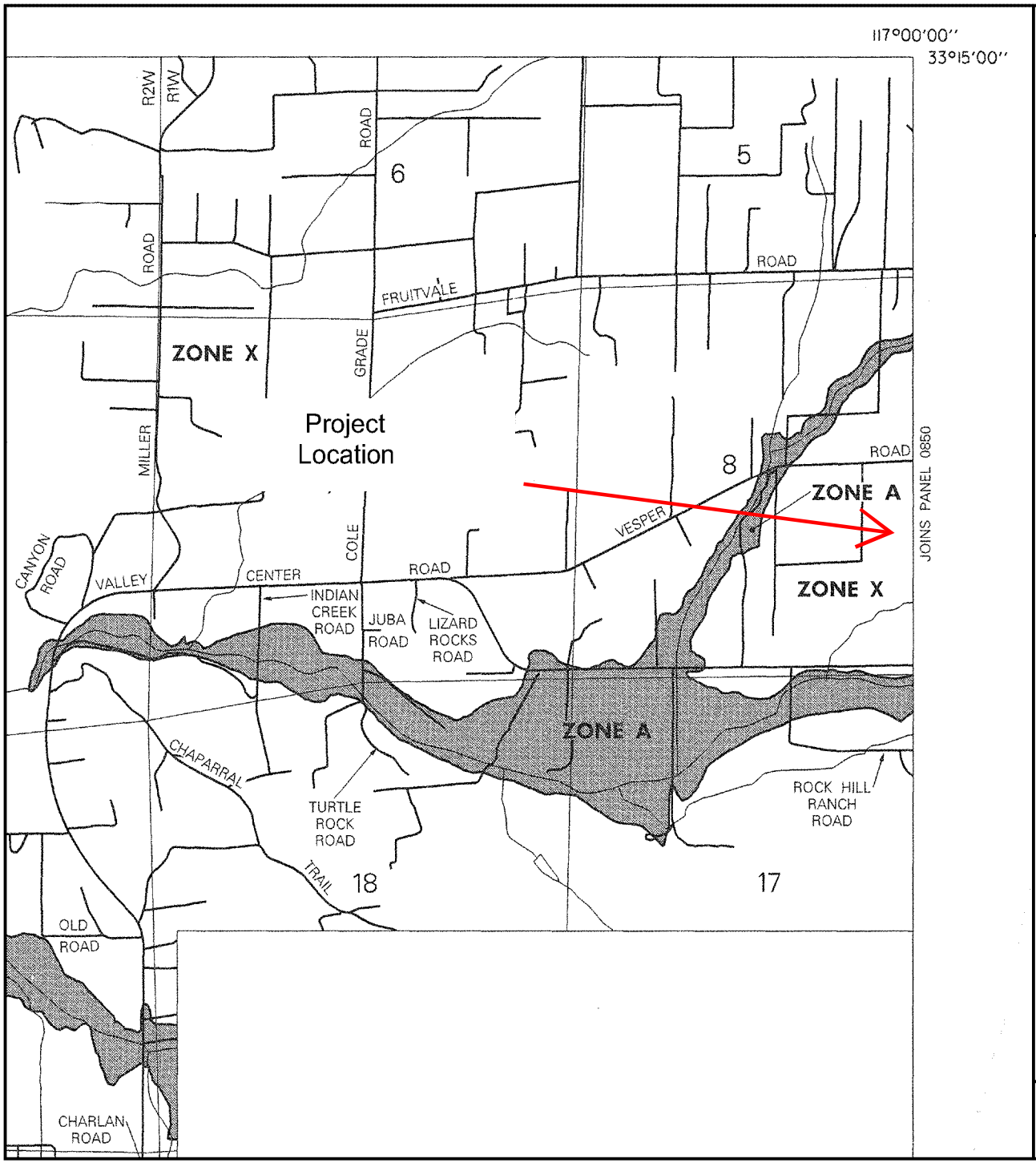
Table 5-6 (Page 1 of 2)

C FACTOR AND P FACTOR VALUES FOR RAINFALL EROSION CONTROL MEASURES

Treatment	C Factor	P Factor
BARE SOIL		
Packed and Smooth	1.00	1.00
Freshly Disked	1.00	0.90
Rough Irregular Surface	1.00	0.90
SEDIMENT BASIN/TRAP	1.00	0.50[A]
STRAW BALE BARRIER, GRAVEL FILTER, SAND BAGS	1.00	0.80
SILT FENCE BARRIER	1.00	0.50
ASPHALT/CONCRETE PAVEMENT	1.00	1.00
GRAVEL (¼" to 1½") @ 135 TONS/ACRE	0.05	1.00
SOD GRASS	0.01	1.00
TEMPORARY VEGETATION/COVER CROP	0.45[B]	1.00
HYDRAULIC MULCH @ 2 TONS/ACRE	0.10[C]	1.00
SOIL SEALANT	0.01 - 0.60[D]	1.00
EROSION CONTROL MATS/BLANKETS	0.10	1.00
HAY OR STRAW DRY MULCH @ 2 TONS/ACRE & ANCHORED		
Assumes planting of grass seed has occurred prior to application, otherwise C Factor = 1.00.		
Slope (%)		
1 to 10	0.06	1.00
11 to 15	0.07	1.00
16 to 20	0.11	1.00
21 to 25	0.14	1.00
25 to 33	0.17	1.00
> 33	0.20	1.00

Attachment E - Floodplain Data

FEMA FIRM



APPROXIMATE SCALE IN FEET

2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 825 OF 2375

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
ESCONDIDO, CITY OF	060290	0825	F
SAN DIEGO, COUNTY OF, UNINCORPORATED AREAS	060284	0825	F

MAP NUMBER
06073C0825 F

EFFECTIVE DATE:
JUNE 19, 1997

Federal Emergency Management Agency

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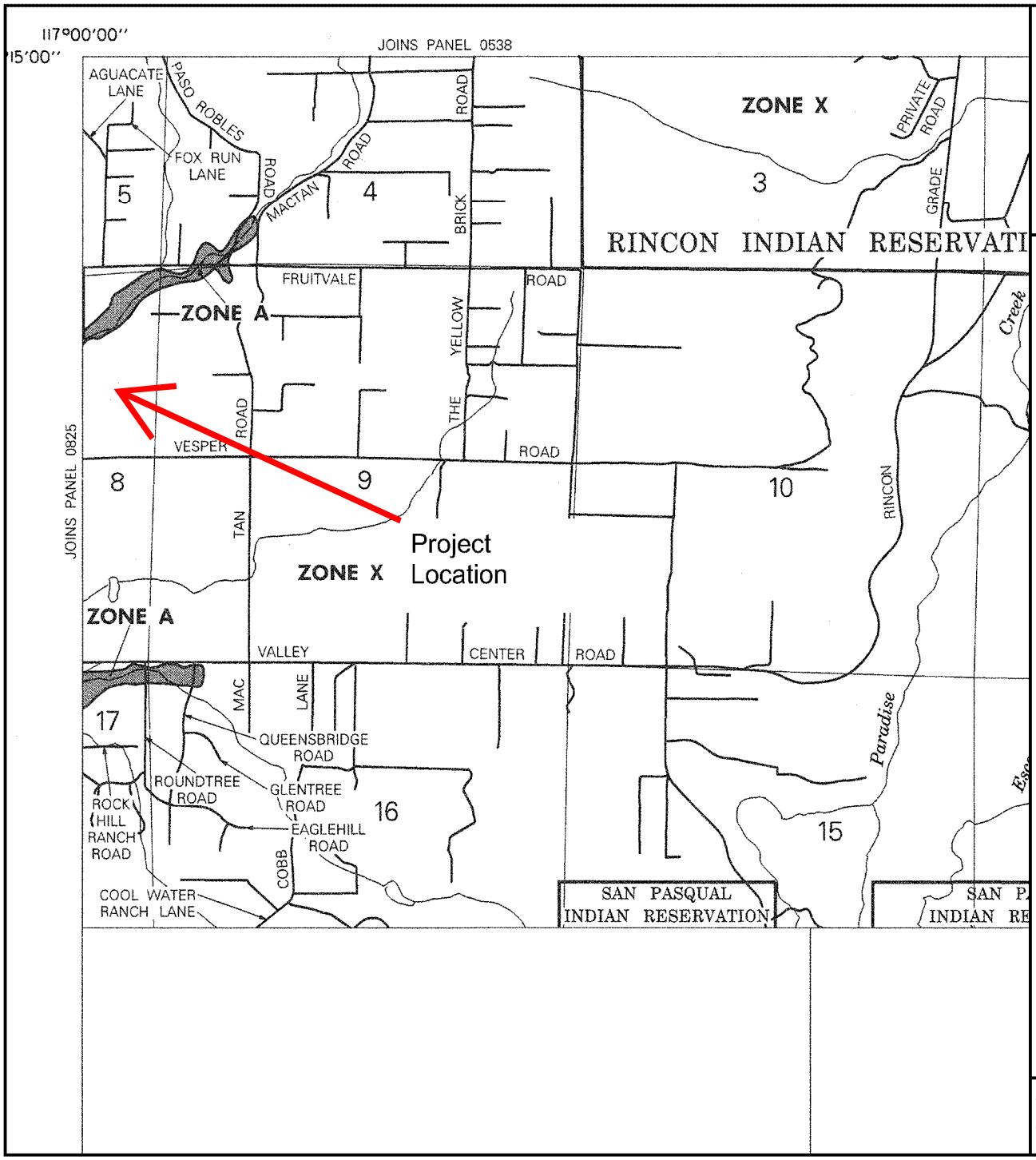

APPROXIMATE SCALE IN FEET

2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 850 OF 2375

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ESCONDIDO, CITY OF	060290	0850	F
SAN DIEGO COUNTY, UNINCORPORATED AREAS	060284	0850	F

MAP NUMBER 06073C0850 F

EFFECTIVE DATE: JUNE 19, 1997

Federal Emergency Management Agency

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Attachment F - Declaration of Responsible Charge

Declaration of Responsible Charge

This drainage study has been prepared under the direction of the following Registered Civil Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based.

The plans and specifications in this drainage study are not for construction purposes; the contractor shall refer to final approved construction documents for plans and specifications.

_____ _____

Jay H. Sullivan
RCE 77445
Exp. 6-30-13

Date